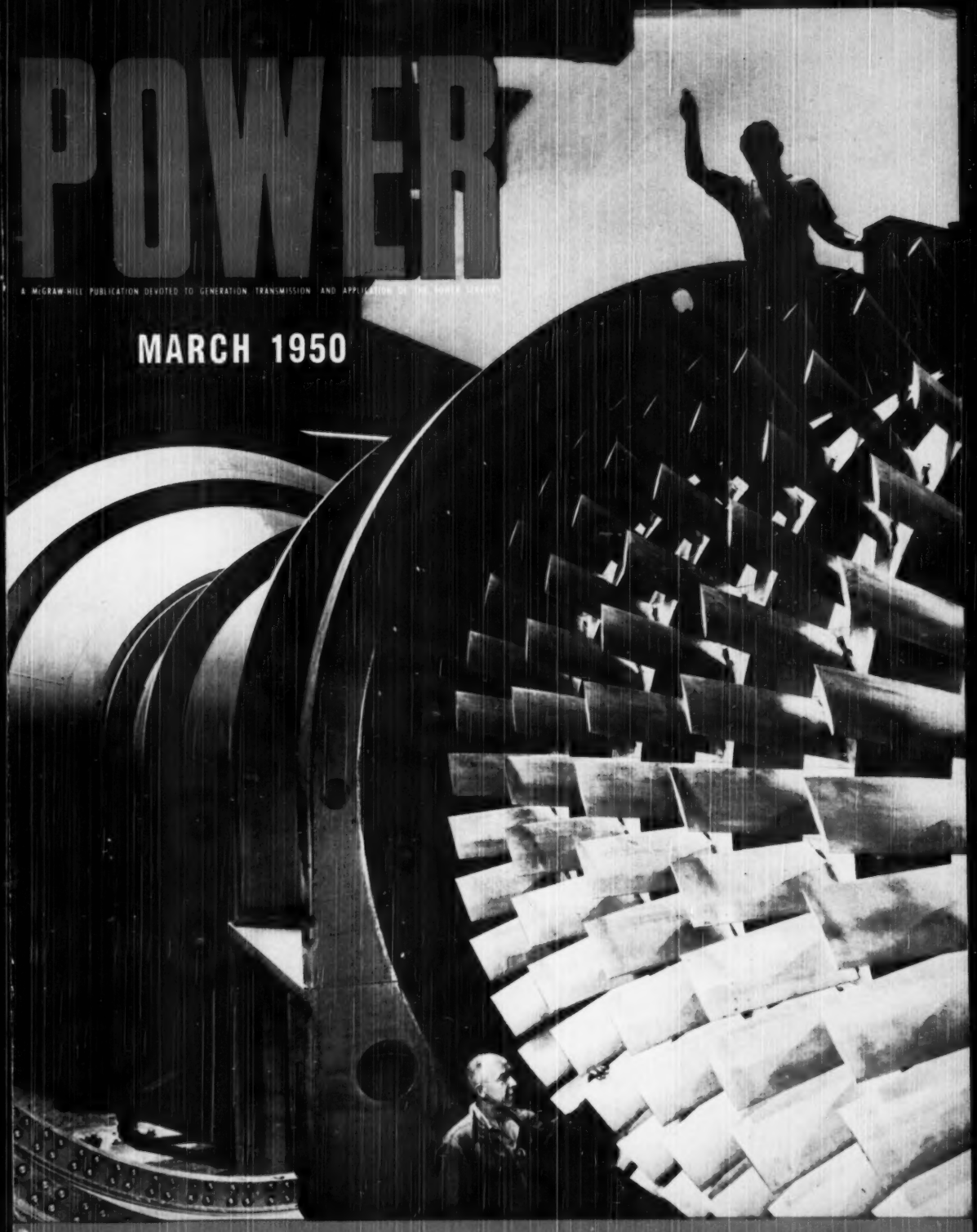
POWER

A McGRAW-HILL PUBLICATION DEVOTED TO GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

MARCH 1950



IN THIS ISSUE: How an industrial plant and a central station put new standard-design mercury-steam units to work, p 76; practical how-to articles on aligning couplings, p 85; removing boiler scale by acid cleaning, p 88; filtering diesel intake air, p 101; also second chapter of heat-insulation handbook, p 113. CONTENTS, p 71

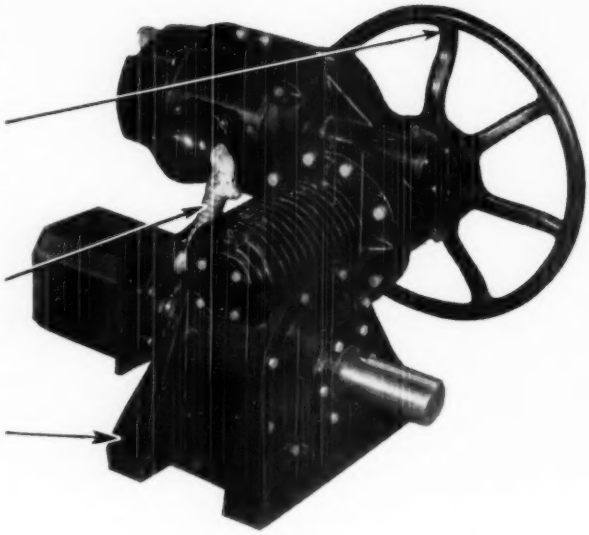
How electric drive units add to reliability of METERMAX COMBUSTION CONTROL

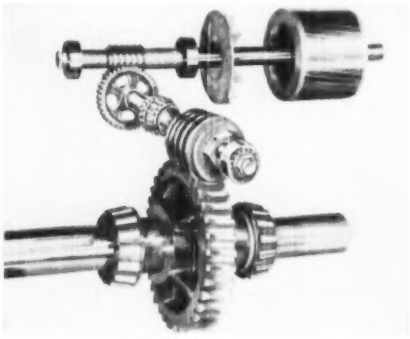
When you're thinking about combustion control, it pays to consider the parts of the system which do the "muscle work" of moving dampers, valves and vanes. In Metermax control, this is done by electric drive units, whose operating features contribute greatly to Metermax performance.

Easy Manual Setting. Ordinarily nothing interferes with the operation of these units except failure of the plant power supply. In emergencies, each controlled element can be moved manually by means of its handwheel. There's no need to disconnect linkages. Gear reduction enables operator to move even heavy dampers easily, quickly.

No Clogging. Because they're operated by electrical power, drive units are immune to clogging and freezing of power lines. Units can be mounted outdoors without any special precautions. Operation is just as reliable as the plant's power supply.

Simple Installation. Complete linkage is provided with each unit. Mounting feet are integral with the drive mechanism—easily bolted to a steel or concrete base.





Self Locking. Output shaft is driven through a double worm and gear reducer which can't be backdriven. When power shuts off, dampers stay in their existing position. No remote locking or reset devices are needed. The drive is always ready to resume control action without any attention by the operator.

Simple Remote Control. With a single switch, operator transfers the whole boiler control from automatic to manual, or vice versa . . . making start-up, shut-down or emergency operation easier.

Accurate Position Indication. Remote indicators on the Metermax panel show true position of controlled elements. Friction load or sticking of dampers cannot cause false position measurement.

For complete details about Metermax Combustion Control, write Leeds & Northrup Company, 4910 Stenton Avenue, Philadelphia 44, Penna.

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

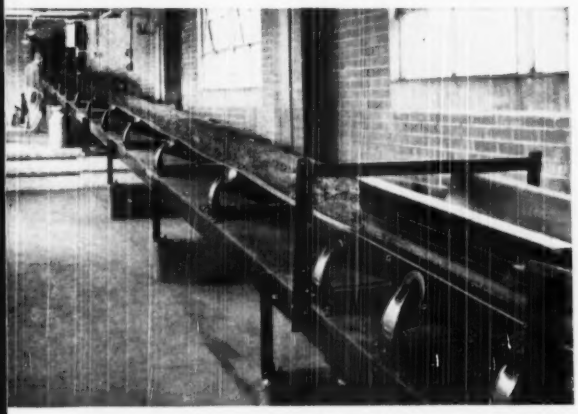
LEEDS & NORTHRUP CO.

Jrl. Ad NU9-01-463(2)

POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer" and "The Stationary Engineer"), March, 1950, Vol. 94, No. 3. Published monthly with an additional Directory number in June. McGraw-Hill Publishing Company, Inc. Editorial and executive offices, 330 West 42nd Street, New York 18, N. Y. Entered as second class matter January 26, 1949, at the post office at New York, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least ten days for change of address. Subscription rates—U. S. and U. S. Possessions $5 for one year, $7 for two years, 65c per copy. Canada $6 for one year, $9 for two years. Pan American Countries, $10 for one year, $16 for two years. All other countries $15 for one year, $25 for two years. Please indicate position and company connection on all subscription orders.

"TWINS" for New York State Electric & Gas Corp.

Link-Belt designed "Hickling" coal handling system duplicates "Jennison"



Above: Link-Belt belt conveyor handling No. 4 anthracite to bunker. Below: Jennison central station. Large illustration at top shows aerial view of Hickling.

Link-Belt integrated coal handling equipment scores again! The new Hickling central station of New York State Electric & Gas Corporation is a duplicate of a Link-Belt equipped station for the same utility, at Bainbridge, N. Y., (Jennison) which has been in operation for some years. Consulting engineers for both plants were Gilbert Associates, Inc.

Link-Belt equipment includes the following: Hopper with grating to receive anthracite from hopper-bottom cars . . . four reciprocating feeders discharging to No. 1 inclined belt conveyor . . . a reclaim hopper at the reserve storage pile with reciprocating feeder to effect uniform delivery to No. 1 inclined belt conveyor . . . bucket elevator for carrying coal from No. 1 belt conveyor to reserve storage or to No. 2 inclined belt conveyor which in turn discharges at 90° into an 18" screw conveyor serving two bunkers, each having a capacity of 350 tons.

We have designed and built a great many coal handling installations for both public utility and industrial power plants. Get in touch with our nearest office.

LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.

11,851

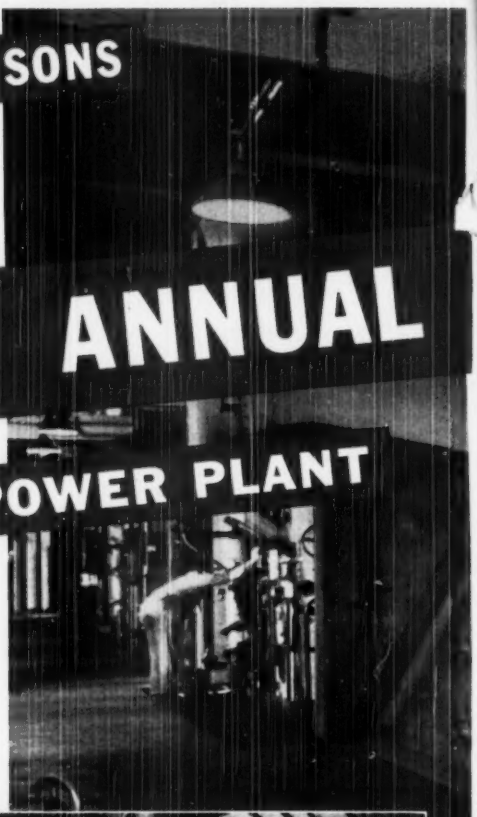
LINK-BELT

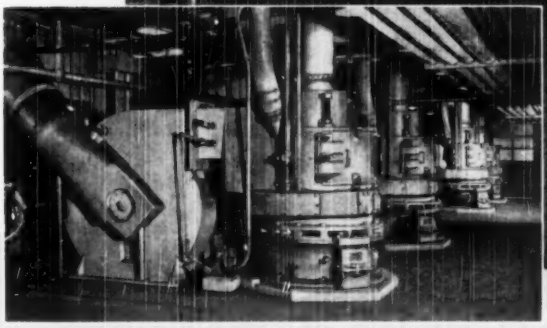
CONVEYING MACHINERY

"THE COMPLETE LINE"

JOHN A. ROEBLING'S SONS *Report*

$250,000 ANNUAL WITH NEW POWER PLANT

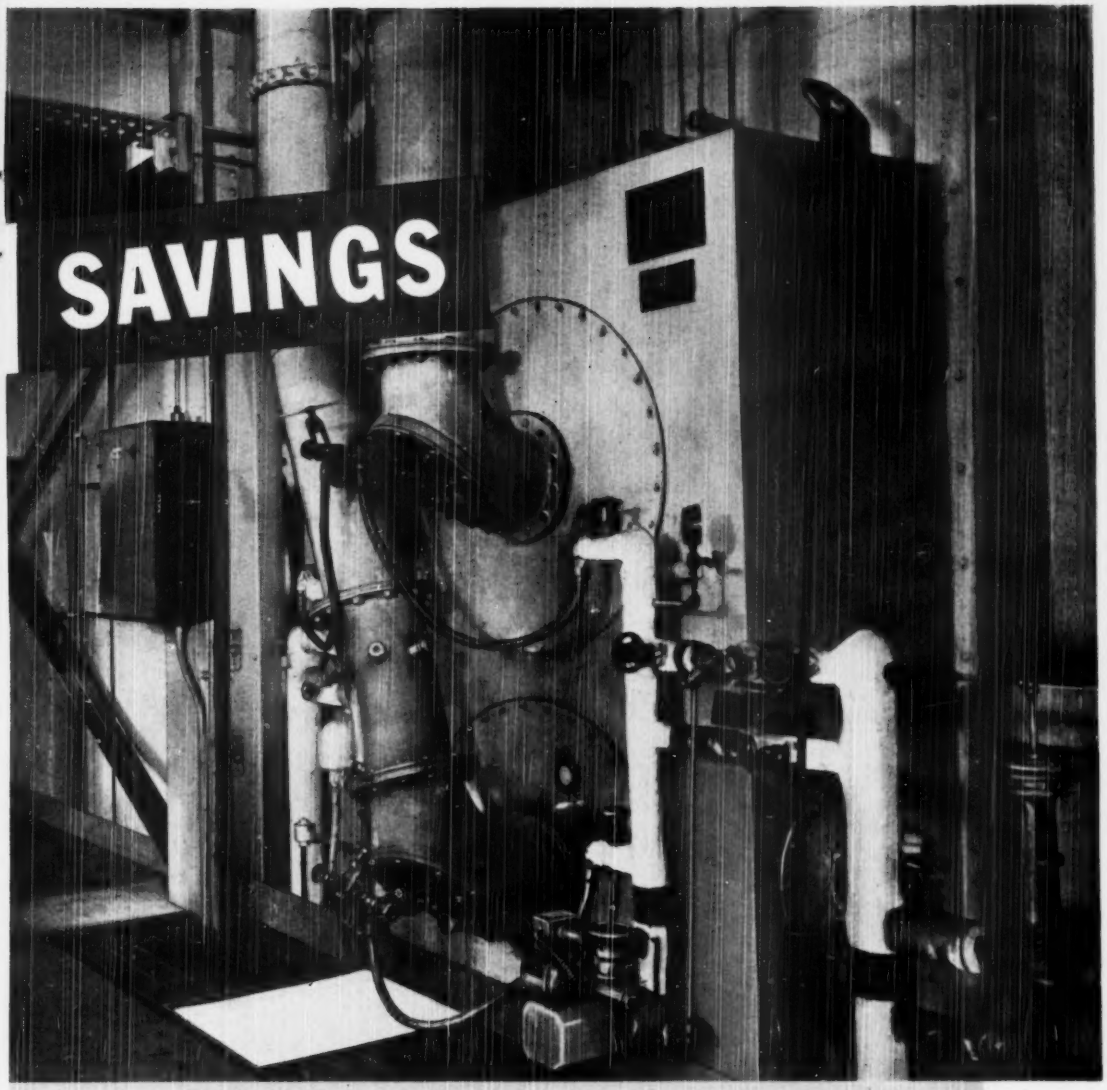




Another Example of B&W Engineering for Economy

Saving a quarter of a million dollars a year with a complete new power plant makes mighty good sense to profit-minded management. And that's just what John A. Roebling's Sons Co., Roebling, N. J., are doing with their new steam and electric generating plant — completely equipped with B&W Integral-Furnace Boilers, Type FH, and with B&W ball-bearing-type Pulverizers.

Generation of by-product electrical energy will result in savings of over $100,000 annually — increased boiler efficiency, reduced maintenance and operating labor costs will add another $150,000. These economies — which include a 9,000 ton annual reduction in coal consumption — are expected to pay for the plant in from 8 to 10 years. Constructors were the Rust Engineering Company.



Three new 80,000 lb. per hr. B&W Integral-Furnace Boilers, Type FH, at John A. Roebling's Sons Company. Combination burners handle pulverized coal or Bunker C Oil. 650 psi steam, supplied to condensing turbine at 750°, is extracted at 150 psi and 510° for processing and heating. Boilers are fired by the three B&W Pulverizers shown in inset.

Like Roebling, you will find new paths to profits opened up when B&W Engineers are in on the start of any modernization or expansion program or the construction of an entirely new plant. Their advice has proved eminently sound for more than 80 years. Write today for Bulletin G-38. It gives you complete details on B&W Integral-Furnace Boilers, Type FH. The Babcock & Wilcox Co., 85 Liberty Street, New York 6, N. Y.

B&W BABCOCK & WILCOX

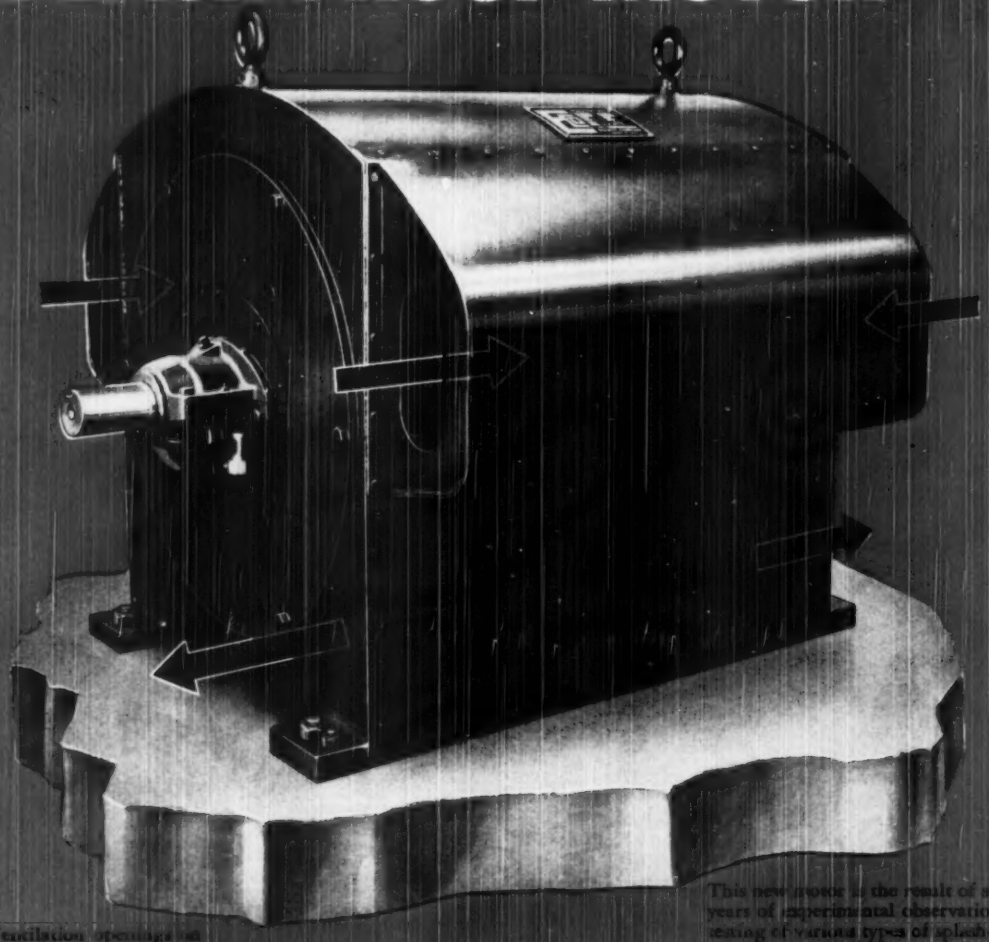
Helping Industry Cut Steam Cost Since 1867

G-442

A revolutionary new

ELLIOTT FABRI-STEEL *outdoor*

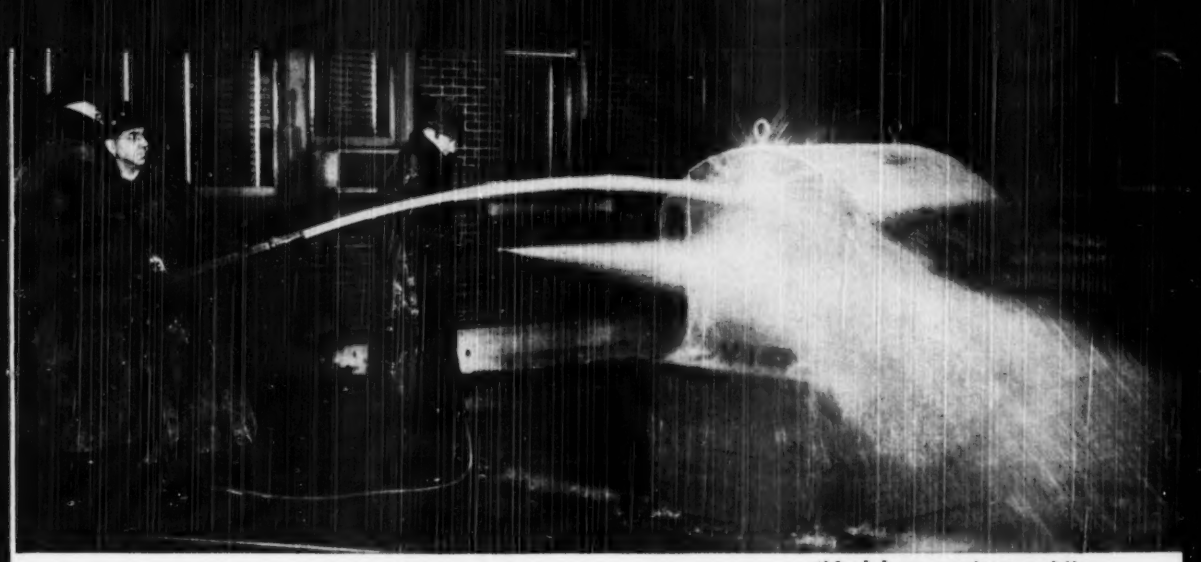
SPLASH-PROOF MOTOR



Ventilation openings on both ends of motor, similarly located.

This new motor is the result of several years of experimental observation and testing of various types of splash-proof motors actually installed outdoors under severe conditions, such as salt fogs, hurricanes, sand storms, etc.

IN MOTORS, IT'S ELLIOTT *all*



"A deluge can't stop it"

- Protected from all directions against wind-driven rain.
- Wind-driven foreign matter blows straight through inlets and outlets without entering motor.
- Inlets and outlets baffled internally—air taken into motor at low velocity.
- Screens or filters may be added to inlets.
- Sealed split ring-oiled sleeve bearings or antifriction bearings.
- Stator coils with mica wrapper on slot portion for 2300-volt and higher class "A" insulation.
- Stator coils are vacuum-pressure impregnated.
- Stator and coils after winding given one complete dip and bake, and end turns two additional dips and bakes.
- Foundation may be a simple, economical slab. Does not need to be special or have expensive cored openings.
- No objectional air recirculation.
- All steel frame and brackets coated inside and out with rust inhibiting finish.

Built in sizes 150 to 2000 hp, 4 to 14 poles.

Contact nearest Elliott Company District Office for details.

L-800

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the way from 1 hp up . . .

there can be no mistake

in reading boiler water level with the

DIAMOND
BI-COLOR
WATER GAUGE

There can be no mistake in reading boiler water level when the Diamond Bi-Color Water Gauge is used. By reason of the unvarying optical law employed, water always shows green—steam always shows red. The contrast is unmistakable . . . and there is no time lag. There are no moving parts. No linkages or extra piping are used and variation in the specific gravity of the water has no effect whatever.

The Bi-Color image is so sharp and clear that it can be mirrored from any reasonable height* and through as many as three grating runways to the firing floor . . . without the slightest confusion. The lower mirror can be made part of the control panel. The Diamond Bi-Color can be easily substituted for most existing water gauges, whether of Diamond or other manufacture.

Diamond Bi-Color has proved its value through many years of successful operation in thousands of boiler plants. Write for Bulletin 1015.

*Where the distance is greater than approximately 100 ft. and multiple mirrors are required, or where the cost of keeping the light path clear of obstructions is a factor, the addition of a Diamond "Utiliscope" is recommended.

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
Diamond Specialty Limited • Windsor, Ontario

4139-A

The DIAMOND "UTILISCOPE"

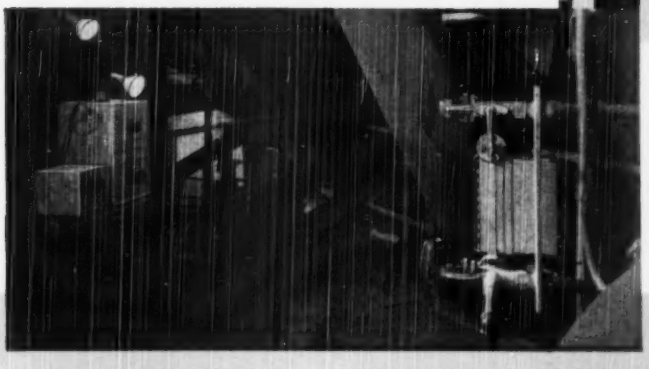
(WIRED TELEVISION)

Brings Boiler Water Level to the Control Panel

there can be no mistake

Regardless of the obstructions and the distance between boiler water level gauge and control panel, the Diamond "Utiliscope" brings an exact instantaneous and continuous picture of the water level to the operator in the control room. There can be no mistake because the "Utiliscope" shows either the correct reading or there is no image.

The continuous picture produced by 60 image fields per second (sound motion pictures have 48) shows *instantly* any change in water level . . . there is no measurable time lag. Among the other advantages of the "Utiliscope" are: sharp contrast, simplicity of design, rugged construction, easy installation, exceptional stability and simple control. It has numerous additional uses such as remote observation of stack discharge, combustion in furnaces, destructive testing, etc. Ask for Bulletin 1025 which will suggest many other applications.



(Above) The "Utiliscope" screen is readily incorporated into the control panel where it is most convenient and always before the operator.

(At left) The "Utiliscope" camera is permanently focused upon the boiler water gauge. It sees and instantly transmits every variation in water level . . . its attention never wanders.

The "Utiliscope" is a product of the Capehart-Farnsworth Corporation and the Diamond Power Specialty Corp.

"Utiliscope"—Registered U.S. Patent Office

DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO

Diamond Specialty Limited, Windsor, Ontario

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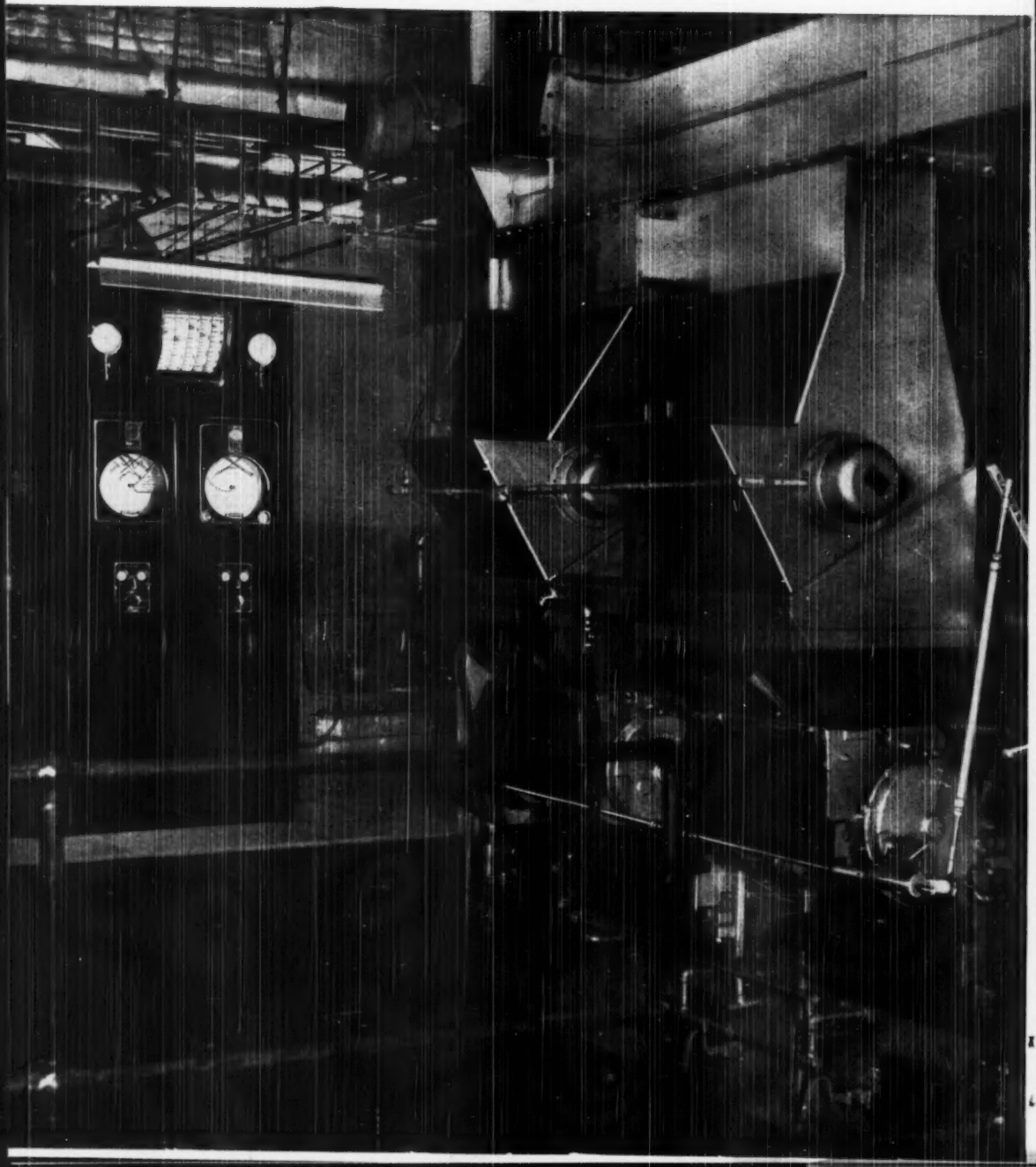
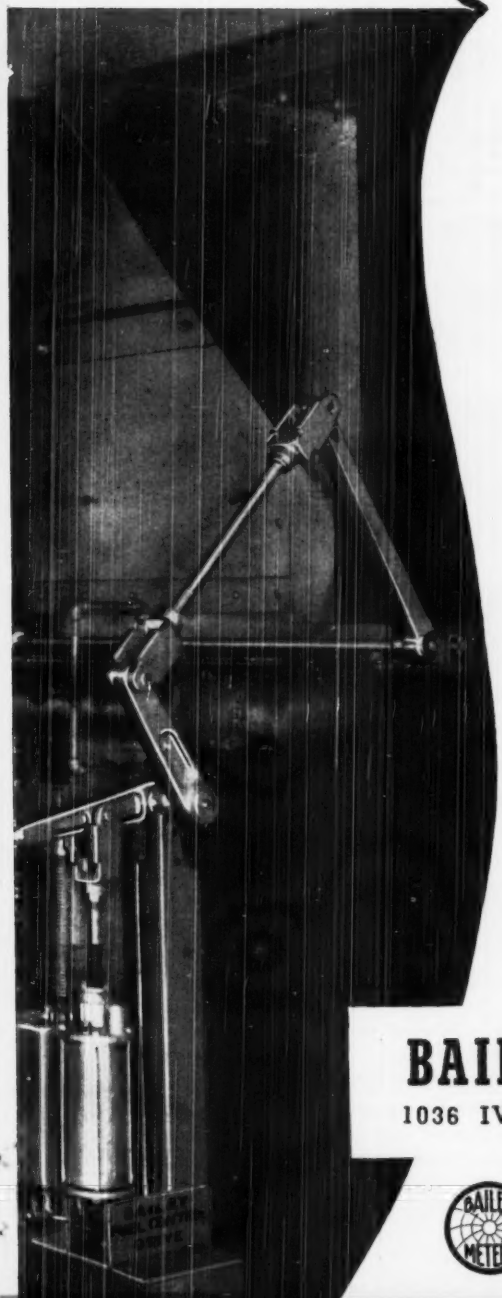
installations like



this... cut power costs



★ This picture is worth a second look. It shows how Engineers are conserving fuel and reducing power costs at International Braid Co., Providence, R. I.

This is an on-the-job picture of Bailey Co-ordinated Boiler Control—the type of control you should now be using to get the most steam for the fewest fuel dollars. With this control you will increase operating safety and improve continuity of service.

The Bailey control drive, shown in the right foreground of this picture, is connected to the coal feed lever of the spreader stoker and regulates the lever in accordance with steam pressure. Similar control drives regulate forced and induced draft dampers to maintain steam pressure, combustion efficiency and furnace draft. In this installation, combustion and feed water controls are co-ordinated to assure optimum boiler operation.

The user reports that prior to installation, it was common to have wide pressure swings during the day. A decided improvement was obtained when this control was installed.

Like all Bailey co-ordinated Boiler Control installations, this one was designed and engineered to the specific job—the same as yours will be. Bailey engineers will work directly with you and your engineers in the application of the meters and controls required by your boilers.

Why not discuss your power problems with a Bailey Engineer? You may be surprised, as many others have, to discover how quickly Bailey Co-ordinated Boiler control will pay for itself in fuel saved. Records show that in many cases installation costs have been returned in less than one year.

A-102

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO

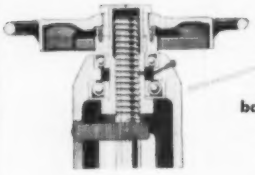
Controls for Steam Plants

COMBUSTION • FEED WATER • TEMPERATURE
PRESSURE • LIQUID LEVEL • FEED PUMPS

You get all these features in

THESE WERE EDWARD FIRSTS!

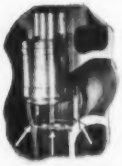
IMPACTOR* HANDWHEEL
Maximum closing torque in minimum space. An all time high in valve design.



EVALTHRUST* YOKE BUSHING
Patented ball bearing construction for easy valve operation.

CLOSURE INDICATORS
No guessing if valve is tightly closed for either regular operation or for special tests.

LOW PRESSURE-LOSS BODY CONTOURS
Both globe and angle bodies let maximum flow through. Pioneered by Edward. Copied but never bettered.

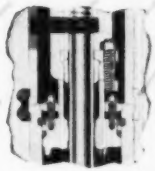


THREE-POINT GUIDING
Streamlined, cored out guide ribs, integral with body, keeps disk in alignment. Dangerous stem guiding eliminated.

SELF-CENTERING DISK THROTTLING LIP
Avoids jamming or cocking, assures tight seating, prevents wire-drawing.

FREE FLOATING TUBULAR DISK-PISTON
Quicker opening, surer closing, flow tested for less pressure loss.

EQUALIZER
Original design. Gives higher, surer piston lift, lowers pressure loss, eliminates wear-producing vibration.



EDWARD PRESSURE-SEAL DESIGN
First pressure-seal non-return valves were built by Edward. Pressure-sealing parts do not guide floating disk-piston, insuring a permanent seal.

INTEX* INTEGRAL SEATS
Hard facing applied directly to valve body completely eliminates possibility of leaks behind screwed or welded-in seat rings.

These are also Edward Firsts!

Evalized* plating of valve parts for wear and corrosion resistance . . . Patented welded-bonnet Univalves* . . . Impactor* handles for small valves . . . Seat located guide ribs in gate valves . . . No-bonnet instrument valve construction . . . Intex* Stellited welded-in seats . . . Hour-glass type disk-piston . . . EValpak* packing . . . Separated feedline stop-check valves . . . Screwed and welded flanges for forged steel valves . . . Swing bolt retaining washer construction, and

***Patented Interchangeability of Stop, Check and Non-Return Valves* . . . Greatest possible valve flexibility for your plant!**

*Registered trade names of Edward Valves, Inc.

Edward Non-Return Valves

DON'T SETTLE FOR LESS!

No valve is more important in your boiler plant than your non-return valve.

From it, you expect quick, sure operation in an emergency. Low pressure loss is important, too.

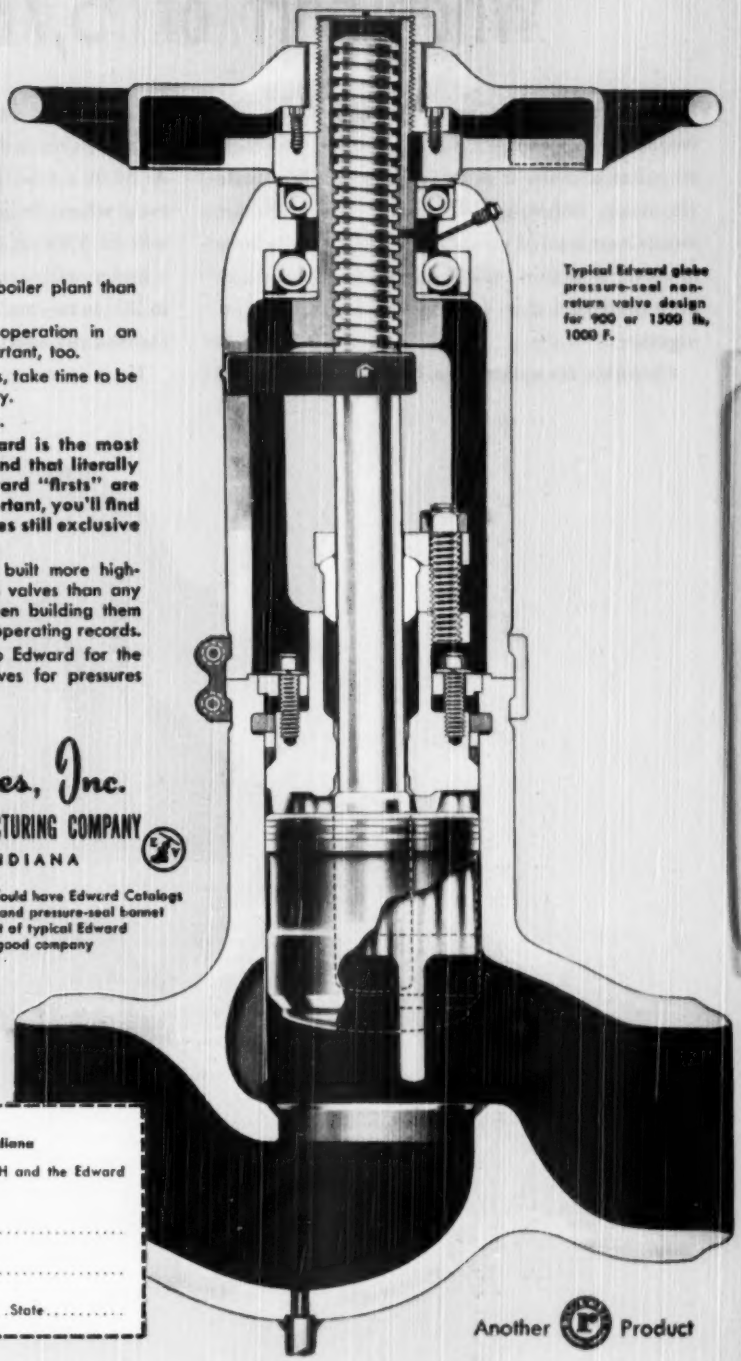
Next time you buy non-return valves, take time to be sure. Go into design features carefully.

Also, look at actual service records.

If you do, you'll find that Edward is the most copied valve in the field. You'll find that literally dozens of features that were Edward "firsts" are now industry standards. More important, you'll find there are still many patented features still exclusive with Edward.

You'll also find that Edward has built more high-pressure high-temperature non-return valves than any other manufacturer . . . and has been building them for more years, piling up unmatched operating records.

Don't discount experience. Look to Edward for the best and the first in non-return valves for pressures from 150 to 2500 lb sp.



Typical Edward globe pressure-seal non-return valve design for 900 or 1500 lb, 1000 F.

Edward Valves, Inc.

Subsidiary of **ROCKWELL MANUFACTURING COMPANY**

EAST CHICAGO, INDIANA

ASK FOR THESE CATALOGS • You should have Edward Catalogs 12-B and 12-H, covering non-return valves and pressure-seal bonnet valves in your file. Also, we'll send you a list of typical Edward non-return valve installations to show what good company you'll be keeping if you specify Edward.

Edward Valves, Inc.
1220 West 144th Street, East Chicago, Indiana

Please send me Catalogs 12-B and 12-H and the Edward non-return valve installation list.

Name.....

Street.....

City.....Zone....State.....

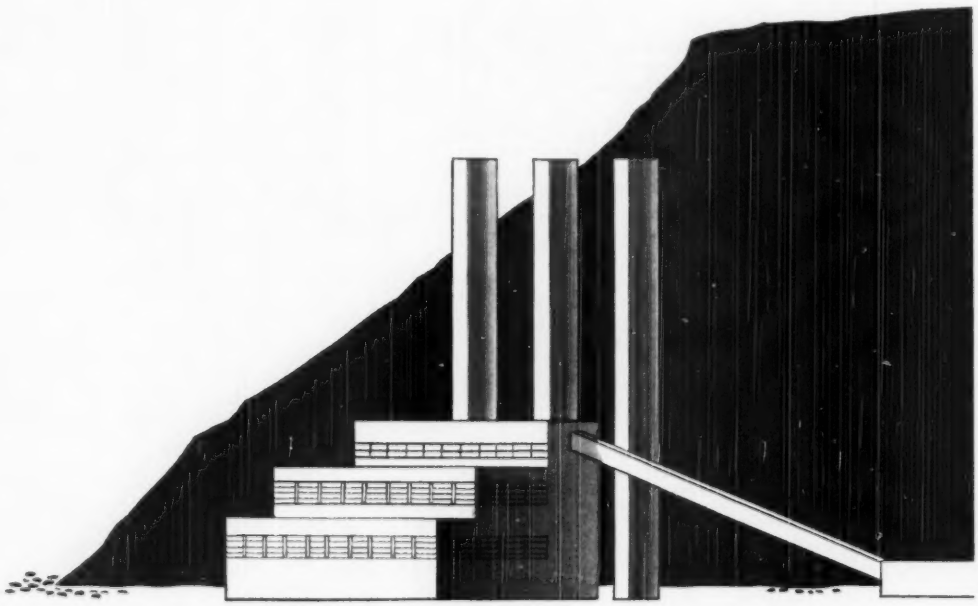
Another Product

What part of $5,760,000 can

When you buy a combustion control system, the second best system is not good enough. No matter what it costs, it is too expensive. Too little air means unburned fuel, while too much air means heat wasted up the stack. Slight variations in either direction can, in a few years, cost more in wasted fuel than boilers and control system together.

Consider, for example, a 100,000 lb/hr boiler, running 24 hours a day, 300 days a year. Coal consumption will be roughly 5 tons an hour. At $8.00 a ton—a moderate price for coal today, even where freight rates are low—the fuel bill will be $960.00 a day, or $288,000 a year. Such a boiler will consume $5,760,000 worth of fuel in 20 years—and 20 years is a conservative estimate of the useful life of boiler and control.

If, in burning that fuel, your control system



HAGAN HALL BUROMIN CALGON

you afford to throw away?

supplies too little air, combustion is incomplete. If it supplies too much, you spend money to heat up the sky. Either way, you lose.

Hagan Automatic Combustion Control Systems are designed for *precise* control. When they are placed in service, they are adjusted by Hagan's experienced combustion engineers, who make sure that you *get* the precision which is built into the control system.

Hagan controls are used on every size of boiler from 5,000 pounds per hour at 3 psi to 1,340,000 pounds per hour at 1800 psi. They have been applied to boilers burning oil, coal, gases of various types, even to boilers burning sawdust —and always with satisfactory results.

Our engineers will be glad to give you full information on Hagan control systems. Write to Hagan Corporation, Hagan Bldg., Pgh. 30, Pa.

HAGAN CORPORATION

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES

in Mechanical Drive Turbines

TYPE DP

For flexible speed control, performance accuracy, and on-the-job reliability, you can't beat a General Electric standard DP turbine with its totally-enclosed hydraulic governing system.

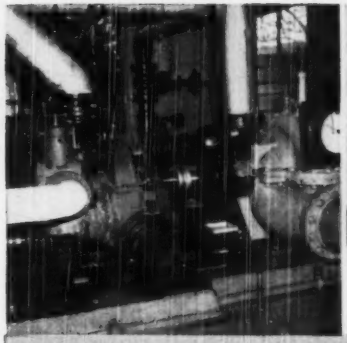
This pressure-relayed system gives you ease and accuracy of control that compares with the precision speed governing of large central station turbines. Yet the DP is a standard design, sold at standard prices.

YOU GET A WIDE SPEED RANGE—30% adjustment for flexibility of operation. This feature, combined with the wide variety of ratings and speeds available, provides you with the "right" turbine for any job.

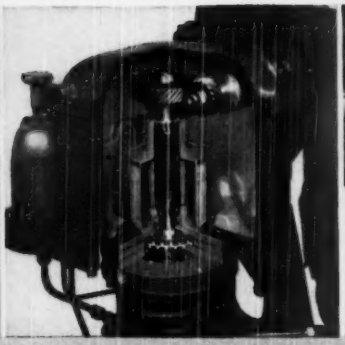
YOU GET PERFORMANCE ACCURACY— 6% regulation means holding the speed you want on important processes. Regulator control is available for governing in terms of any process requirement.

YOU GET GREATER RELIABILITY— the hydraulic governing system keeps moving parts to a minimum, operates in an oil atmosphere with no exposed linkages. This eliminates wear and corrosion, assures dependable operation.

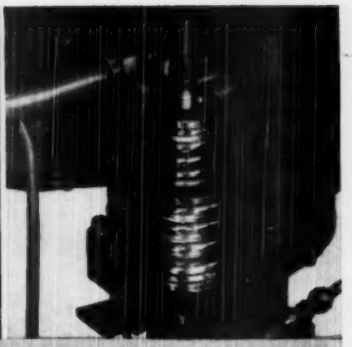
Check the features of the standard DP. It can give you the kind of precision performance you're looking for, the savings in operating costs that boost profits. Contact your nearest G-E sales office, or write for bulletin GEA-4955A. Apparatus Dept., General Electric Co., Schenectady 5, N. Y.



In this plant, a General Electric 30-hp DP turbine is coupled to a centrifugal pump. The hydraulic governing system provides accurate, reliable performance over a wide range of speed adjustment.

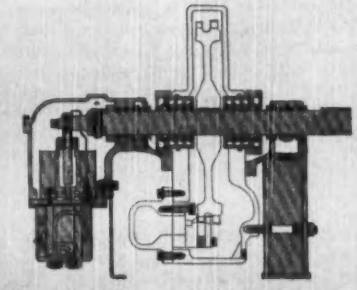


This turbine-type oil pump, gear driven from the main shaft, signals any tendency for the DP to speed up or slow down with changes in load. The pump also provides oil pressure for positioning the governor valve.



Acting on the speed signal from the oil pump, this pressure relay controls the amount of oil pressure in the operating cylinder. This cylinder regulates the amount of steam admitted to the turbine through the governing valve.

HYDRAULIC GOVERNING makes a difference



Here's What Standardization Provides For You

In the diagram at the left, all shaded parts are interchangeable on all sizes of DP turbines. Thus, it is easy to stock spares, and maintenance costs are reduced. All models have standard shaft height and coupling fits for easy installation or re-location in your plant. Standardization cuts manufacturing expense and the savings are passed on to you in the form of extra features usually found only on "special" turbines.

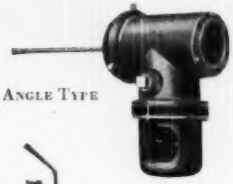
GENERAL ELECTRIC

THE HOTTEST NEWS IN FLAME SAFETY

. . THE ALL-NEW PROTECTOGLO!

STRAIGHT TYPE

FLAME-ELECTRODE RECTIFIERS *for non-luminous gas*



ANGLE TYPE

FLAME - RECTIFIER PILOT—*a combined flame-electrode rectifier and gas pilot burner assembly*

PHOTOCELL RECTIFIER —*is ideal detector unit for use with luminous flames*

AND there are a lot of good reasons why the all-new Protectoglo is receiving such an enthusiastic reception. In addition to the versatility demonstrated by the availability of the four different flame detector units pictured above, the new Protectoglo boasts these outstanding features:

- *Automatic Self-Checking, without manual push-button, provides "Safe-Start" Circuit and safeguards against component failure.*
- *Positive Flame Failure Protection through the* rectification principle *which eliminates unsafe conditions due to grounding . . . does not rely on flame conductivity or resistance.*
- *Expensive shielded cable not required.*
- *Plug-In Timer is optional for purge timing.*
- *Relite is possible without additional relays.*

BROWN INSTRUMENTS — WORLD'S LARGEST ORGANIZATION FOR ADVANCED INSTRUMENTATION AND CONTROL

Call in your local Honeywell engineer for detailed information . . . or write for a copy of Specification Sheet 526.

The All-New Protectoglo Is Now Available For Immediate Delivery!

MINNEAPOLIS-HONEYWELL REGULATOR CO.
BROWN INSTRUMENTS DIVISION
4490 Wayne Ave., Philadelphia 44, Pa.
Offices in 73 principal cities of the United States, Canada and throughout the world

Honeywell — *Advanced Instrumentation* FOR BETTER PROCESSING — BROWN

Which of these Corrective Chemicals is Best for Your Power Plant?

☐ **Akon**

An effective oxygen absorbent and sludge coagulant for boilers, either internally or externally treated.

☐ **Akon Bricks**

A solid composed of Akon and softening chemicals for internal treatment in low to medium pressure ranges.

☐ **Silimite**

Effective high magnesium dolomitic lime for silica reduction in connection with a hot process soda softener.

☐ **No. 20 Series**

Powdered formulations designed to control excessive scale and corrosion problems in plant cooling cycles.

☐ **No. 26 Internal Treatment**

Used as oxygen scavenger and sludge dispersive agent for boilers, either internally or externally treated.

☐ **No. 30 Series**

Powdered formulations combining all of the necessary softening chemicals with an organic dispersive material.

☐ **No. 40 Series**

Powdered formulations for scale and corrosion control as supplementary treatment for boilers in *all* pressure ranges.

☐ **No. 60 Series**

Powdered formulations for inhibiting corrosion in brine and circulating water systems and low pressure boiler plants.

☐ **No. 160 Series**

A liquid formulation of the volatile amines for corrosion control in condensate return systems.

☐ **A-C Anti-Foam**

An effective formulation to overcome damaging foaming in boilers operating over 150 psig.

Carl H. Grinnell, with 25 years experience in power plant water conditioning, is one of the Allis-Chalmers specialists located around the country to advise you on correct water conditioning equipment, chemicals and service. For free survey, call your nearby Allis-Chalmers office!

FOR OVER HALF A CENTURY, Allis-Chalmers has been building power generation equipment. This experience is invaluable in providing our water conditioning specialists with the extensive background needed today to recommend, not only the correct equipment, but corrective chemicals and comprehensive service as well.

Whatever your industry—paper, petroleum, food, steel—you'll get prompt, convincing results with Allis-Chalmers water conditioning service. An expert representative is available, ready to recommend proper chemicals or help select the right process for your power plant requirements. Get in touch with him today at your Allis-Chalmers Office for complete information.

Akon and *Silimite* are Allis-Chalmers trademarks.

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Water Conditioning

✓ EQUIPMENT ✓ CHEMICALS ✓ SERVICE

ALLIS-CHALMERS, 952A SO. 70 ST. MILWAUKEE, WIS.

Gentlemen:

Please send me specific information on the following chemicals:

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Name _____

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Company _____

Address _____

City _____ State _____ A-2910

...FOR Steel Valves

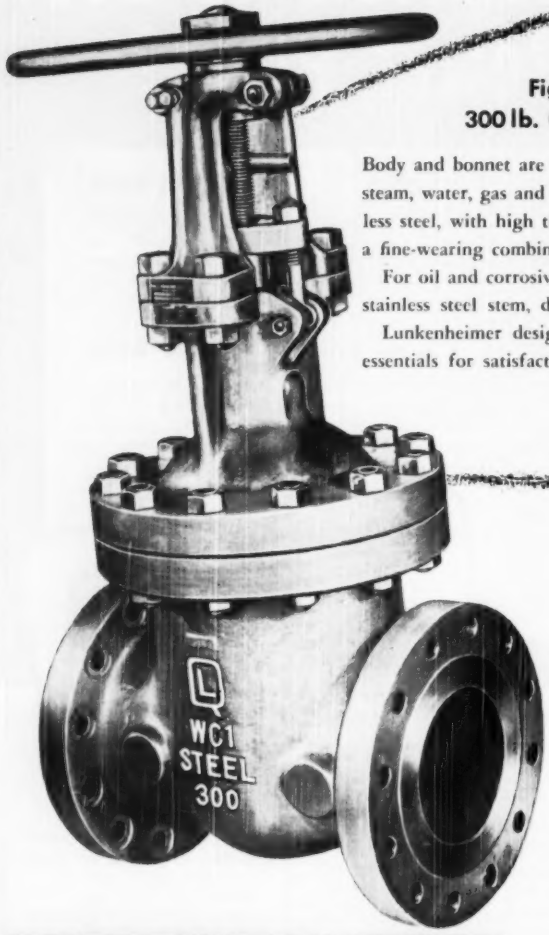


Fig.1938-WD6
300 lb. CAST STEEL GATE

Body and bonnet are of Carbon Molybdenum Steel. For steam, water, gas and air service, disc and stem are stainless steel, with high tin content nickel alloy seat rings—a fine-wearing combination developed by Lunkenheimer.

For oil and corrosive service, valves are furnished with stainless steel stem, disc faces and seat rings.

Lunkenheimer design and construction insure all the essentials for satisfactory and low-cost service.

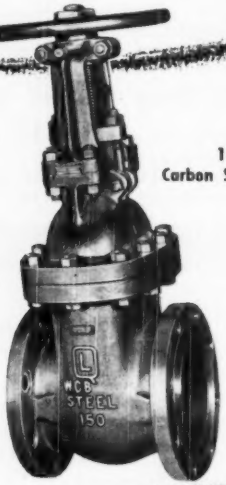


Fig. 1751
150 lb. S.P.GATE
Carbon Steel Body and Bonnet

A battery of heavy duty universal turret lathes, typical of Lunkenheimer's continuous modernization program, machining Steel Valve bodies. New equipment of all kinds; the latest in valve metallurgy and design; plus traditional Lunkenheimer craftsmanship, assure continually improved products which mean better, lower-cost valve service.

YOU CAN'T GO WRONG ON LUNKENHEIMER!

THE trend toward wider use of steel valves for many services makes Lunkenheimer, who pioneered the development and production of high pressure-high temperature designs, a logical and dependable source of supply.

Here you have top metallurgical research, sound engineering knowledge and design, advanced foundry methods under rigid control in our own steel foundry, most modern tools and manufacturing equipment, plus wide experience, to guide you in the selection of your requirements.

The valves illustrated are but two of a complete line of steel valves for every industrial purpose. Available in a variety of alloys and trims to suit specific applications . . . gate, globe, angle and check patterns, 150 lb. to 2500 lb. and higher pressures; screw, flange or welding ends. Complete information is given in Steel Valve Catalog No. 553, available on request.

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

CINCINNATI 14, OHIO, U.S.A.

NEW YORK 13 • CHICAGO 6 • BOSTON 10 • PHILADELPHIA 34

EXPORT DEPT. CINCINNATI 14, OHIO, U.S.A.

Helpful Service at Your Call...

Lunkenheimer representatives and sales engineers will be glad to work with you on any problem of valve installation and usage. And for your immediate maintenance requirements, call your Lunkenheimer Distributor. He is well qualified to take care of your needs.

Leadership through Achievement!

6 reasons why

...Industry after Industry has selected the VERTICAL-UNIT BOILER

AUTOMOBILE
BAKERIES
BREWERIES
CEMENT
CHEMICAL
COLD STORAGE
DAIRIES
DISTILLERIES
FOOD
GLASS
HOSIERY
HOSPITALS
INSTITUTIONS
LAUNDRIES
LEATHER
LINOLEUM
MACHINERY
METALS
OIL
PACKING
PAINT
PAPER
RAILROADS
RUBBER
SCHOOLS
STEEL
SUGAR
TEXTILE
TOBACCO
UTILITY

A glass plant in Ohio ... a chemical plant in West Virginia ... a floor covering plant in Delaware ... plant after plant, representative of virtually every branch of industry, has chosen the C-E Vertical-Unit Boiler, Type VU-10 to meet its particular steam requirements. Here are six important reasons for the VU-10's industry wide acceptance:

Balanced Design – Not one or two features for special needs, but a *completely balanced design* that adapts itself to many conditions. A design in which each element is coordinated with every other for top performance.

Efficient Performance – The VU-10 has high efficiency over a wide range of output, produces steam of satisfactory quality at all ratings and responds to rapid load swings ... all characteristics of advantage to many industrial plants.

Easy Operation and Maintenance – The VU-10 is simple to operate and maintain – especially advantageous for plants with limited operating and maintenance forces. All parts readily accessible for such cleaning and maintenance work as may be necessary.

Choice of Fuels and Firing – In addition to its wide adaptability, the VU-10 permits you to choose the one *best* method of firing for the fuel and load conditions of *your* plant.

Lower Cost – The standardized balanced design of the Vertical-Unit Boiler effects economies in engineering, fabrication and erection which are passed on to you in lower first cost.

Unified Responsibility – The Vertical-Unit Boiler is a complete unit ... boiler, furnace setting, fuel-burning equipment, controls, forced draft ... bringing you the added benefit of one contract, one guarantee and one responsibility.

• • •

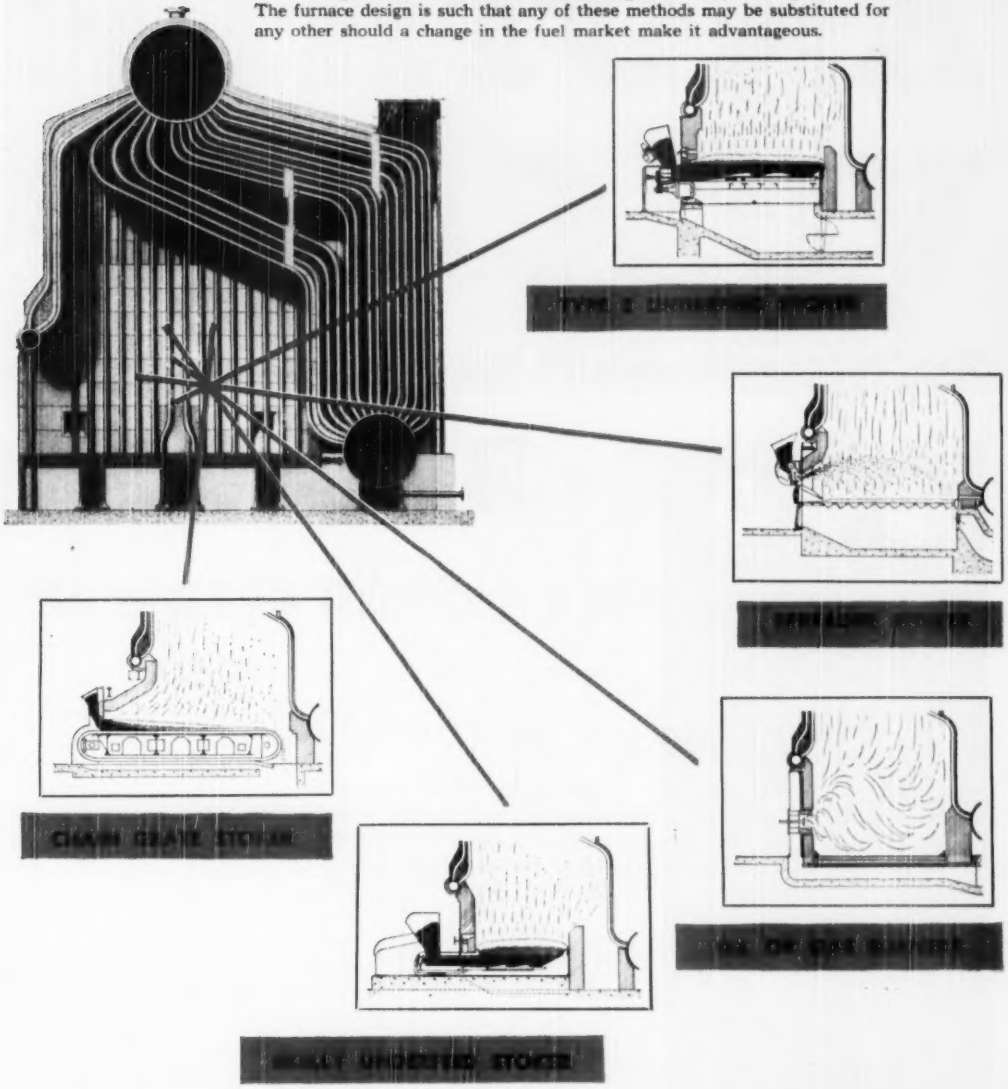
The design, construction and operating features of the VU-10 meet all the requirements of a modern industrial plant. Small wonder so many diverse industries select this unit for their steam needs. If your requirements fall within the capacity range, 10,000 to 60,000 lb of steam per hour, it will pay you to investigate the VU-10. Our engineers will welcome the opportunity to discuss the matter with you or your consultants at your convenience. B-381

COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

For every fuel market and every type of load there is *one best* method of firing. The selection of that *one best* method for the fuel and load conditions of a particular plant calls for judgment based on broad experience and free from any incentive to favor one type of equipment over another.

The Type VU-10 Boiler is designed for five methods of firing—spreader stoker, single-retort underfeed stoker, chain grate stoker, oil or gas burners. The furnace design is such that any of these methods may be substituted for any other should a change in the fuel market make it advantageous.

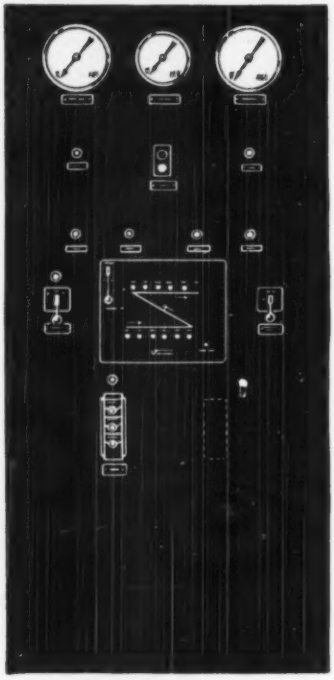


— SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

ANOTHER VULCAN 1ST

The Vulcan Automatic Sequential Soot Blowing

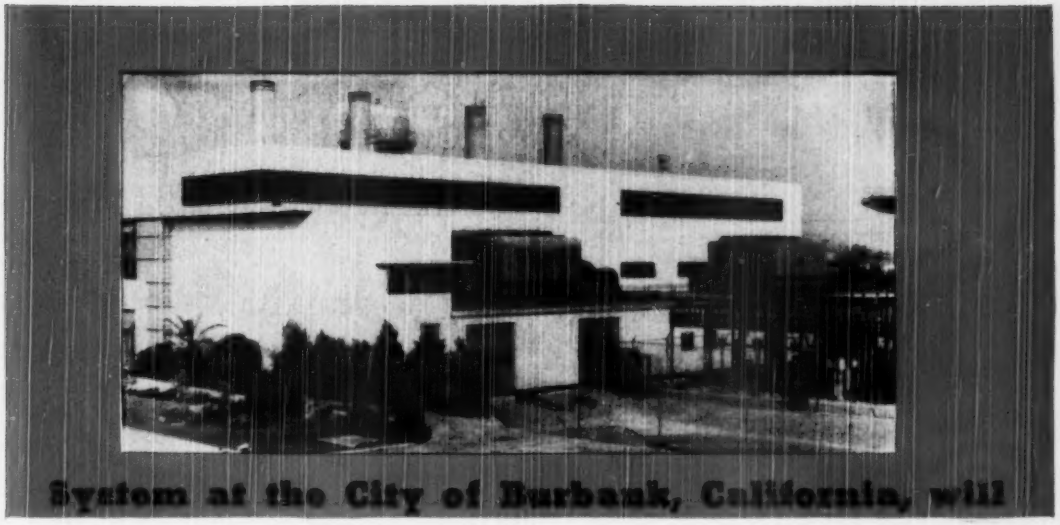


• Blow with

• No change in

Panel for the Vulcan Automatic Sequential Soot Blowing System for City of Burbank's new C-E boiler rated at 225,000 pounds per hour. 875 psi. 910 F.

VULCAN *Automatic*



System at the City of Burbank, California, will

AIR—or with STEAM

equipment . . . Simply operate 2 valves

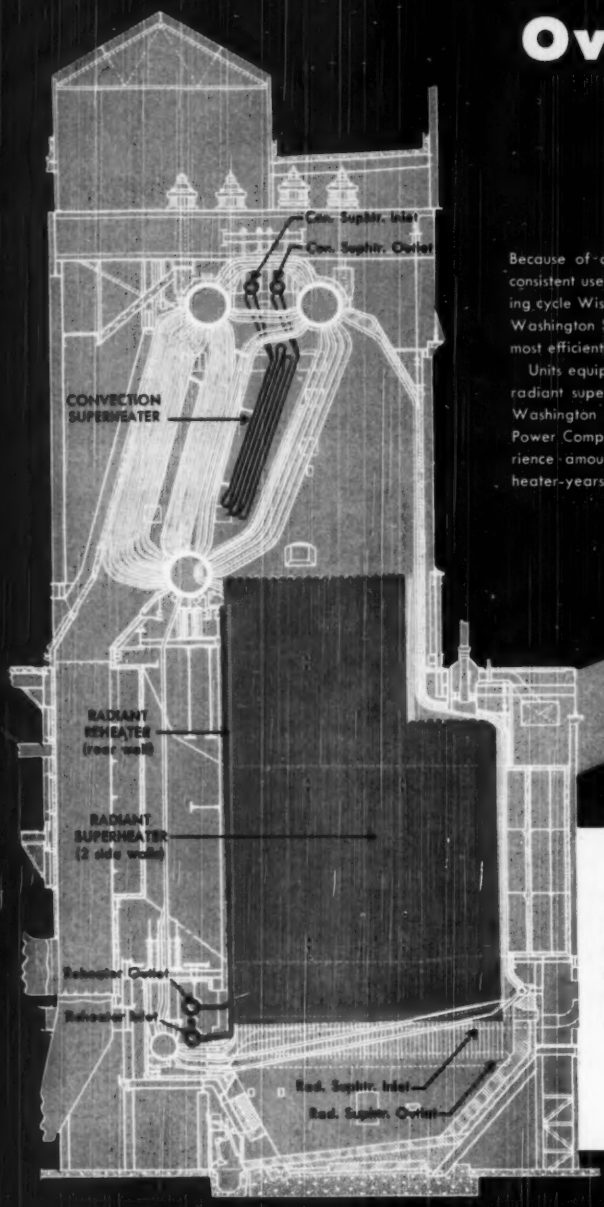
SIMPLY close one valve and open another—and this unique Vulcan soot blowing system uses either compressed air or steam as the cleaning medium. This dual-media system assures:

BETTER CLEANING: You have high-pressure steam instantly ready if needed to combat severe slagging, or if air supply fails. You have 100 percent soot blower availability.

LOWER COST: You need but one air compressor, saving about 40 percent of the cost of the standard air installation.

VULCAN SOOT BLOWER DIVISION
Continental Foundry & Machine Company
Du BOIS, PENNSYLVANIA

Over 500

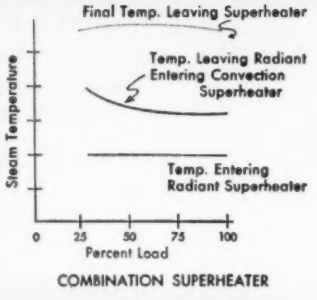


Because of a farsighted program involving the consistent use of a high temperature resuperheating cycle Wisconsin Electric Power Company's Port Washington Station is today one of the country's most efficient power plants.

Units equipped with FW radiant reheaters and radiant superheaters at both Lakeside and Port Washington Stations of the Wisconsin Electric Power Company show a total of successful experience amounting to over 500 "radiant superheater-years."

1949

FOSTER



COMBINATION SUPERHEATER

Fig. 1
Note flat final steam temperature

FOSTER WHEELER CORPORATION

"Radiant superheater-years" in one utility alone*

*See TRANSACTIONS of the ASME, August, 1949, page 738

1948 1943 1935 1929

WHEELER RADIANT REHEATERS and SUPERHEATERS

Foster Wheeler Radiant Superheaters. Foster Wheeler experience in the design and operation of radiant and convection surface dates from 1902 with the introduction of commercial use of superheated steam into the United States. ***A wider selection of fuels*** for resuperheating units may be obtained by using superheaters and reheaters which include FW radiant heat absorbing sections. This is in sharp contrast to the all convection type which will provide a wide range of steam temperature control at the risk of considerable slagging in both furnace and hotter convection zones. This also applies in the case of non-reheat units with wide control ranges. Performance data on units equipped with FW radiant surfaces for superheating and resuperheating at the Lakeside and Port Washington Stations of the Wisconsin Electric Power Company also testify to such advantages as ***a very high operating reliability*** and ***the compensating effect in temperature characteristics*** as against exclusively convection arrangements with steep load temperature curves (see figures 1 and 2). The fact that 35.6% of the total BTU duty on Unit No. 5 at Port Washington will be performed by the superheater and reheater well illustrates the magnitude of this function of a modern steam generator.

Availability at Port Washington Station. To date, four units incorporating FW radiant reheating and radiant and convection superheaters have been installed in the Port Washington Station. The fourth unit was started in August 1949 and a fifth is in fabrication. The combined availability of the first three operating units, the initial one of which was installed in 1936, is 95% for a total of 147,235 hours of service as of December 26th, 1948.

For further information, write for Paper No. 48-A-120

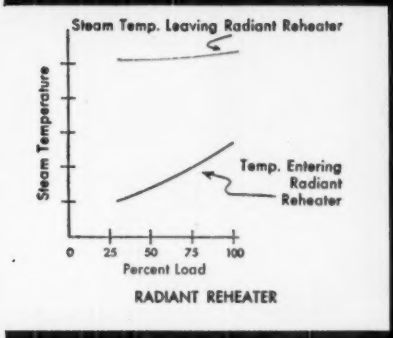


Fig. 2
characteristics over wide load ranges

165 BROADWAY, NEW YORK 6, N.Y.

FOSTER WHEELER

POWELL VALVES have *these* "ABILITIES" to a high degree:

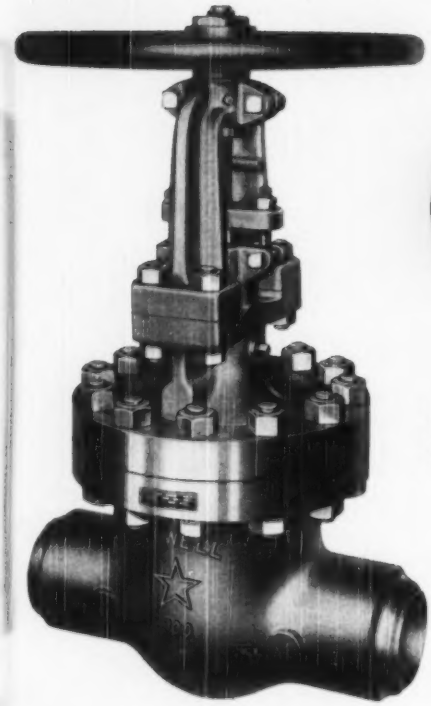


Fig. 9003 W. E. — Class 900-pound Cast Steel Gate Valve with welding ends, outside screw rising stem, bolted flanged yoke and tapered solid wedge.

Fig. 11323 W. E.—Class 1500-pound Cast Steel Pressure Seal Gate Valve with welding ends. Has top-mounted electric motor operator for quick positive opening and closing. →

POWELL

ADAPTABILITY. The Powell Line is so complete* that there's a Powell Valve especially adapted, in design and material, to meet the requirements of each and every industrial flow control service.

DURABILITY. Powell Valves are noted for their durability. That is because each Powell Valve is built to stand up under the specific flow control conditions to which it may be subjected.

DEPENDABILITY. Every Powell Valve is specifically designed to give dependable, uninterrupted service over a long period of time. That is why Powell Valves reduce costly "down time" for maintenance to a minimum.

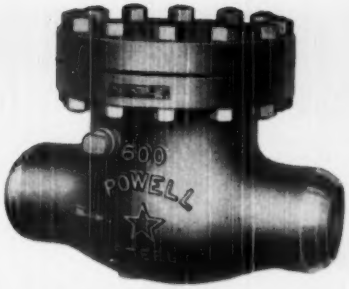


Fig. 6061 W. E.—Class 600-pound Cast Steel Swing Check Valve with welding ends and bolted cap. Disc has ample lift to permit full, straightway, unobstructed flow through the valve body.

Fig. 1793 — Large 125-pound Iron Body Bronze Mounted Gate Valve. Made in sizes 2" to 30", inclusive. Has outside screw rising stem, bolted flanged yoke and tapered solid wedge.

Fig. 560—200-pound Bronze Regrinding Horizontal Swing Check Valve with screwed ends, screwed-on cap and regrindable, renewable bronze disc.

Fig. 375—200 pound Bronze Gate Valve. Screwed ends, inside screw rising stem, union bonnet and renewable wear resisting "Powellium" nickel-bronze disc.

Fig. 1708—200-pound Bronze Globe Valve with screwed ends, union bonnet, renewable, specially heat treated stainless steel seat and regrindable, renewable, wear-resisting "Powellium nickel-bronze disc.

Fig. 1314-A — Class 1500-pound Steel Integral Bonnet "Y" Valve. Also made in Globe and Angle patterns.

***The Complete Powell Line includes Globe, Angle, "Y", Gate, Check, Non-return, Relief, and Flush Bottom Tank Valves in Bronze, Iron, Steel and a wide range of Corrosion-resistant metals and alloys.**

Ask your nearest Distributor or write direct

The Wm. Powell Company, Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

VALVES

. . . All Handled by

CLARAGE HEAVY-DUTY EQUIPMENT

IN NEW MUNICIPAL POWER PLANT, LITCHFIELD, MINN.

CONSULTING ENGINEERS: PFEIFER and SHULTZ, MINNEAPOLIS PLANT SUPERINTENDENT: W. W. VIEBAHN

Seventeen years ago the City of Litchfield, Minnesota purchased a Clarage forced draft fan for its original power plant . . .

That fan is still in continuous service. *Maintenance to date one bearing repair job, cost $28.40.*

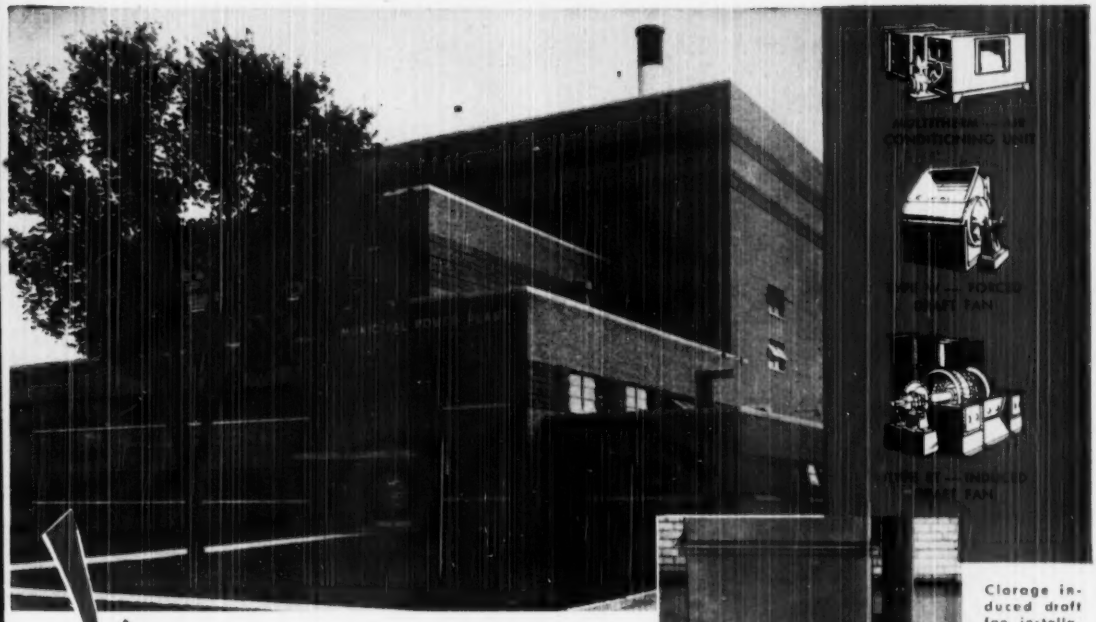
Last year Litchfield placed in operation its new $1,100,000 power plant shown here — and again Clarage HEAVY-DUTY equipment was chosen.

In the new plant, a Clarage Type W (18,700 CFM) forced draft fan and a Clarage Type RT (32,575 CFM) induced draft fan meet the air combustion requirements of the 45,000-pound boiler. W. W. Viebahn, superintendent, states that Clarage equipment was favored a second time due to the *"satisfactory service and negligible upkeep"* of his first installation.

You, too, can help your power plant maintain a top performance, low cost record by selecting Clarage HEAVY-DUTY mechanical draft equipment.

We are specialists in this field, manufacturing a complete line for all needs. It will most certainly pay you to consult with us.

More than 3,000 Power Plants are Clarage Equipped



Clarage induced draft fan installation at Litchfield plant. As shown, fan is direct motor driven and has water-cooled bearings.

Office Air Conditioning at Practically No Operating Cost

All offices in this new Litchfield power plant are completely conditioned by a Clarage HEAVY-DUTY *Zone Control* air conditioning unit.

Steam air heaters within the Clarage unit are operated in cold weather. In the summer time, the air is cooled with a heat exchanger which uses the cold make-up water to the power plant cooling tower. *By utilizing this make-up water, air conditioning costs are practically non-existent.*

Chances are that a Clarage air conditioning installation in YOUR plant can be operated with equal economy. Why not at least investigate?

CLARAGE

—HEADQUARTERS for Air Handling and Conditioning Equipment

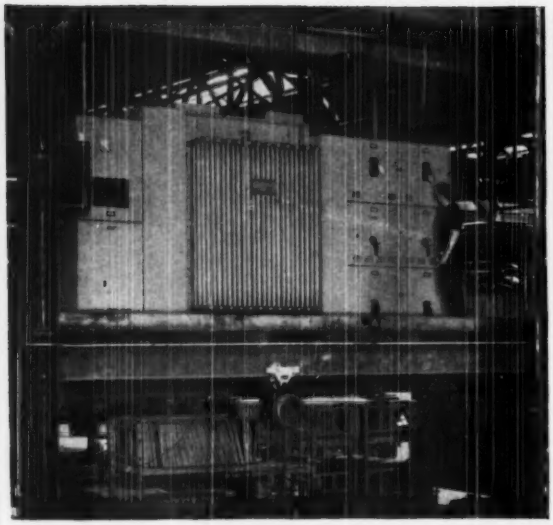
CLARAGE FAN COMPANY

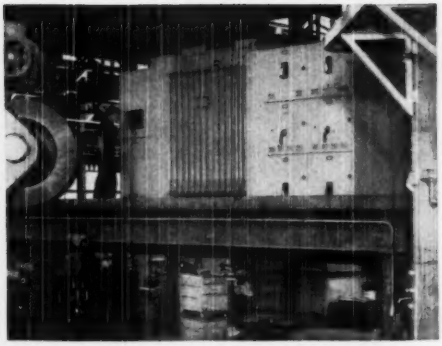
KALAMAZOO, MICHIGAN

Any air handling or conditioning inquiry directed our way is in capable hands . . . phone our office in your city, or write us.

SEE OUR CATALOG IN SWEET'S

Application Engineering Offices in All Principal Cities



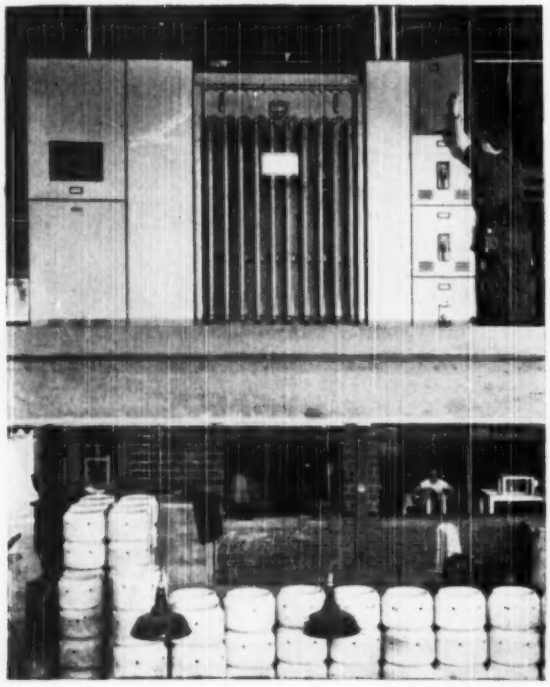


ALL UNIT SUBSTATIONS MOUNTED ON PLATFORMS TO SAVE FLOOR SPACE

Two views of General Electric 1000-kva load-center unit substation at new Maytag plant. Valuable manufacturing space is saved by locating units on platforms under the roof, right over the center of the load area. Air switch on primary is easy to operate, contacts are easy to see. Air circuit breakers on secondary are of the drawout type, easily removable for inspection and maintenance. Note entire load center is metal enclosed, thus offering operating safety to personnel.

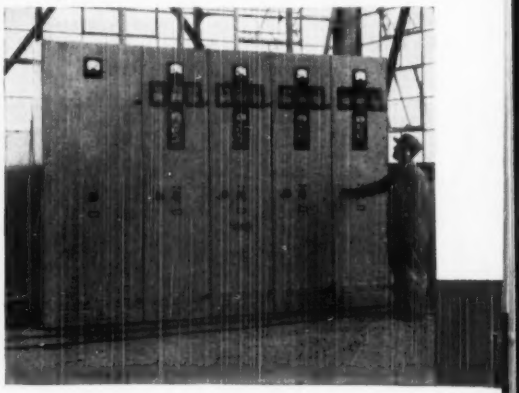
LOAD-CENTER

UNIT SUBSTATIONS

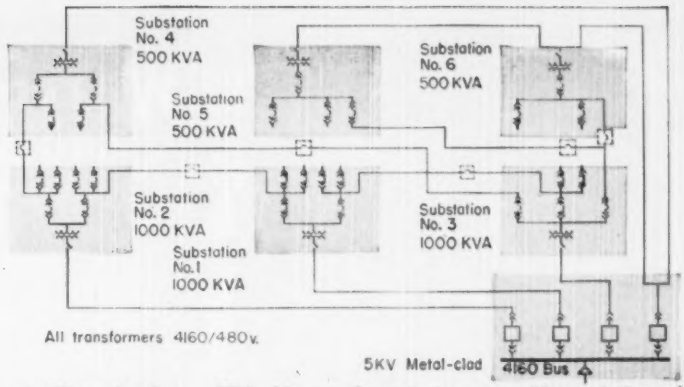


Unit substation No. 5, rated 500 kva. Air circuit breaker for future circuit can be inserted in empty upper housing. Drawout breakers are G-E Type AK-1 with 25,000 ampere interrupting rating—plenty of "IC" (Interrupting Capacity) to handle all short circuits. Contacts of 5 kv air switch are clearly visible through window, another safety feature of G-E substations.

G-E 5-kv metal-clad switchgear handles 4160 volts incoming power, distributes it to six load-center unit substations where it is stepped down to 480 volts for utilization. Metal-clad switchgear is neat in appearance, saving in space, and offers safety to operating personnel. Additional sections can be added for future expansion with a minimum of bother and expense.



CONTINUOUS POWER ASSURED MAYTAG BY SECONDARY-SELECTIVE DISTRIBUTION SYSTEM



This secondary-selective system at the new Maytag installation uses General Electric metal-clad switchgear to handle the incoming 4160 volts through four magne-blast power circuit breakers. Feeders distribute the 4160-volt power to six G-E load-center unit susbstations throughout the building where the high-voltage is stepped down to 480 volts for utilization—right at the center of the load area. This eliminates long, costly secondary feeders. Air switches on the primary of all load centers are rated 5 kv. Key interlocks give operating safety to personnel by preventing breaking of the load current with the air switch, or paralleling transformers.

With this secondary-selective system Maytag is insured against a power shutdown in case of failure of any one transformer or its primary feeder cable. If trouble occurs the normally open tie breaker is closed, thus providing an alternate source of power that permits the plant to operate at slightly reduced capacity.

The Maytag installation is a complete General Electric project—one source of responsibility plus the very best in coordinated planning, engineering, manufacturing, and service facilities to give maximum savings and efficiency to the customer.

HELP SPEED PRODUCTION AT THE NEW *Maytag* PLANT AT NEWTON, IOWA

ONLY G-E LOAD CENTERS GIVE YOU THESE FEATURES . . . .

SELECTED STANDARD ratings have been introduced by General Electric to bring you load centers on 20 per cent shorter shipments. The most popular are—

Low voltage	480 △ or Y, 208Y/120 volts
High voltage	2.4, 4.16, 4.8, 12, 13.2, 13.8 kv, delta
Kva ratings	300, 500, 750, 1000, 1500, 2000

Certain other *selected standard* load centers are available. Contact your G-E sales representative for further information.

NEAT APPEARANCE . . . Note the smooth, integrated appearance of these G-E unit substations . . . no more gawky, "old-type" stovepipe connections between transformer and switchgear.

SAVE TIME by eliminating weeks spent over drawing boards detailing individual items. G-E factory-assembled unit substations are quickly and easily installed with lower material and labor costs than required for "piece-meal," makeshift affairs. No last minute "alterations" with hacksaws and cold chisels to make them fit.

INVESTIGATE TODAY how General Electric unit substations can be used in your plant for efficient, flexible power distribution. Contact your G-E sales representative for further information, and write today for the helpful bulletins listed below. *Apparatus Department, General Electric Company, Schenectady 5, New York.*

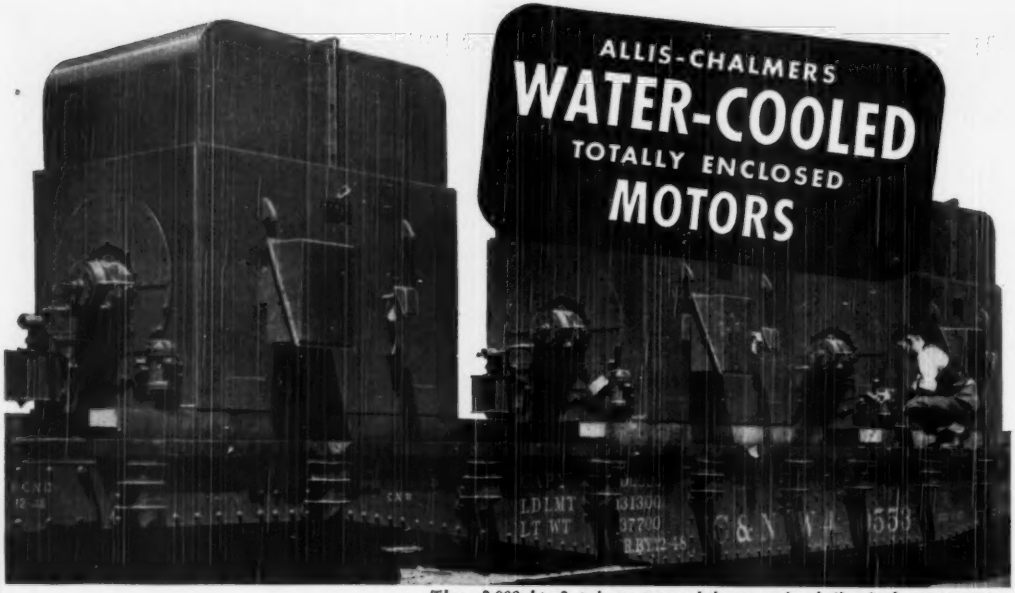
GEA-3592 Load-center Unit Substations
GEA-3758 Load-center Power Distribution
GEA-3083 Metal-clad Switchgear
GEA-4057 Interlocked-armor Cable for Primary Circuits
GEA-4352 Flamenol Cable for Secondary Circuits

"For our new plant that manufactures Maytag automatic washers, we wanted the very best in power distribution systems. That's why we chose a secondary-selective system using General Electric load-center unit substations. We found that a system such as this would be more economical than any other type. Even though the initial cost was slightly higher than a simple radial system, the fact that we were assured of continuous power for our manufacturing facilities, even though a transformer or feeder cable should drop out, meant that we would save time and money in the long run. We also chose a load-center system because we can easily expand it to take care of any increase in our manufacturing facilities. We also bought 'standard' unit substations because we discovered they would do the job just as well as 'specials'—and at far less cost—and because we could get better delivery. After the units arrived they were installed on the platforms and were operating in a very short time. And dealing with one organization saved us time and money because we could get the engineering, equipment, and service all from one reliable source."

L. C. McAnly, Sr., Manager of Manufacturing,
The Maytag Co., Newton, Iowa

Be sure to see the "More Power to America" full-color sound slidefilm "Modern Industrial Power Distribution." Ask your G-E sales representative to arrange a showing for your organization.

GENERAL ELECTRIC



Three 2,000-hp, 2 pole, water-cooled motors for boiler feed pump service.

DIRT-PROOF

COOLER Dissipate motor heat in water. Keep heat out of power-house.

QUIETER Lower sound level where unusually quiet motors are required.

AND Protect against dirt, corrosion and moisture. Permit outdoor installations.

YOU CAN PRACTICALLY ELIMINATE maintenance due to dust, dirt, fly ash, and moisture by using Allis-Chalmers water-cooled, totally enclosed construction for power plant auxiliary motors.

Place these protected motors outdoors or indoors, and you'll enjoy positive dirt protection. Indoors there'll be less heat in the power-house — especially in the summer time.

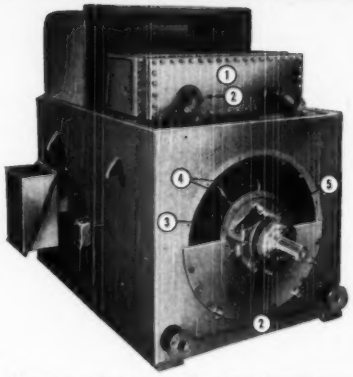
In addition, you'll find that this A-C ventilating and cooling system lowers the sound level.

Motors of this type can be provided for the larger power-house auxiliary drives. Size and weight are not appreciably increased over open motors of the same rating.

For complete information, outline your requirements to your nearby A-C Sales Office, or write direct. A-2973

ALLIS-CHALMERS, 952A SO. 70 ST.
MILWAUKEE. WIS.

WATER-COOLED MOTOR CONSTRUCTION



1. Air-to-water heat exchanger
2. Water connections
3. Rotor fan
4. Air pressure lines to bearing oil guard to prevent oil leakage into windings
5. Capsule type bearing

ALLIS-CHALMERS

Young turbine with a bright future . . .

● OFFICIALS of a midwest power company have every reason to believe that their new 40,000-KW turbine, shown above, will never have to be shut down for oil replacement, oil system cleaning, or because of oil acidity troubles. Their convictions are based on their own experience with Nonpareil Turbine Oil.

Since 1940, this company has put Nonpareil Turbine Oil into five big turbines, including the new unit. These five turbines have a total capacity of 188,500 KW. During the *one to nine years of operation* on Nonpareil, neutralization numbers have stayed below .06 mg. KOH/gm. There have been no time losses or troubles caused by high acidity. Oil systems have not required cleaning. Such benefits are assured this company, not only for 8 or 10 years, but for the *life* of its turbines. This assurance is based on Nonpareil's written guarantee that it will maintain a neutralization number below 0.15 mg. KOH/gm.

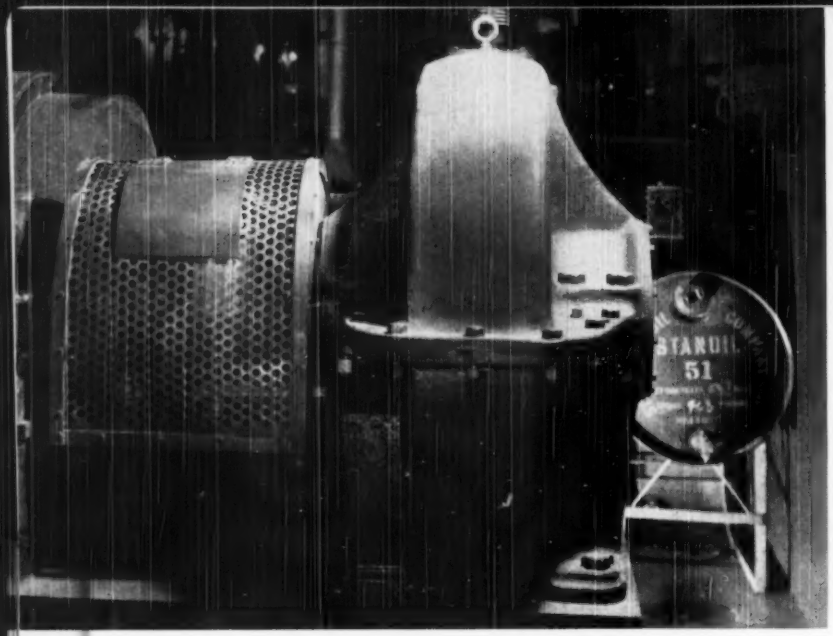
Why not end oil system maintenance and oil-acidity troubles, once and for all, by using Nonpareil Turbine Oil in your turbines? For more evidence of these savings, ask a Standard Oil Lubrication Engineer to supply you data from 20-year service records of Nonpareil Turbine Oil.

Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

NONPAREIL
Turbine Oil

"Will outlast your turbine"

STANDARD OIL COMPANY (INDIANA) STANDARD



Arrest the dirty work in reduction gears

THE dirty work starts in reduction gears when the lubricating oil begins to oxidize and break down under the attack of heat and air. Oxidation products, uniting with dust and other foreign matter, form deposits which interfere with proper lubrication and cause gear wear.

STANOIL
TRADE MARK
Industrial Oil

You can head off this dirty work—avoid costly cleaning jobs, oil changes, and gear wear—by using STANOIL Industrial Oil. The high stability of STANOIL prevents deterioration by heat. Its low-carbon-forming base oil keeps gears free from carbon. An inhibitor curbs acidity growth which would cause the formation of emulsions and sludge.

The many qualities of this one oil enable it to handle a wide variety of jobs in your plant. To assure you maximum benefits from STANOIL and other high-quality petroleum products, the Standard Oil Company has a well-trained and experienced lubrication specialist located practically at your doorstep. How you can profit by this unique product-service combination is explained at the right.

Standard Oil Company (Indiana), 910 S. Michigan Avenue, Chicago 80, Illinois.

What's YOUR problem?

● To help you solve particular lubrication problems or gain greater all-around economy, Standard Oil has set up an industrial service that's unrivalled in the Midwest. This service puts at your immediate disposal the help of a highly trained, experienced lubrication specialist and a reliable supply of petroleum products. All you need do is phone or address a card to the nearest Standard Oil Company (Indiana) office. In fact, why not start right now by arranging for the visit of the lubrication specialist assigned to your plant. With his help, find how many different oils in your plant can be replaced by STANOIL Industrial Oil on such applications as:

Hydraulic systems... cleaner operation, no foaming troubles.

Air compressors ... no sticking or clogging of valves, less oil consumption in splash or circulating systems.

Speed reducers ... less wear of gears and bearings during frequent cold starts or prolonged high-temperature operation.

Steam turbines ... freedom from emulsions and sludge, fewer oil changes necessary.

Ring-oiled bearings ... rings function immediately on starting, less bearing wear.

Circulating and bath systems ...one oil for a wide variety of jobs.

STANDARD **STANDARD OIL COMPANY (INDIANA)**

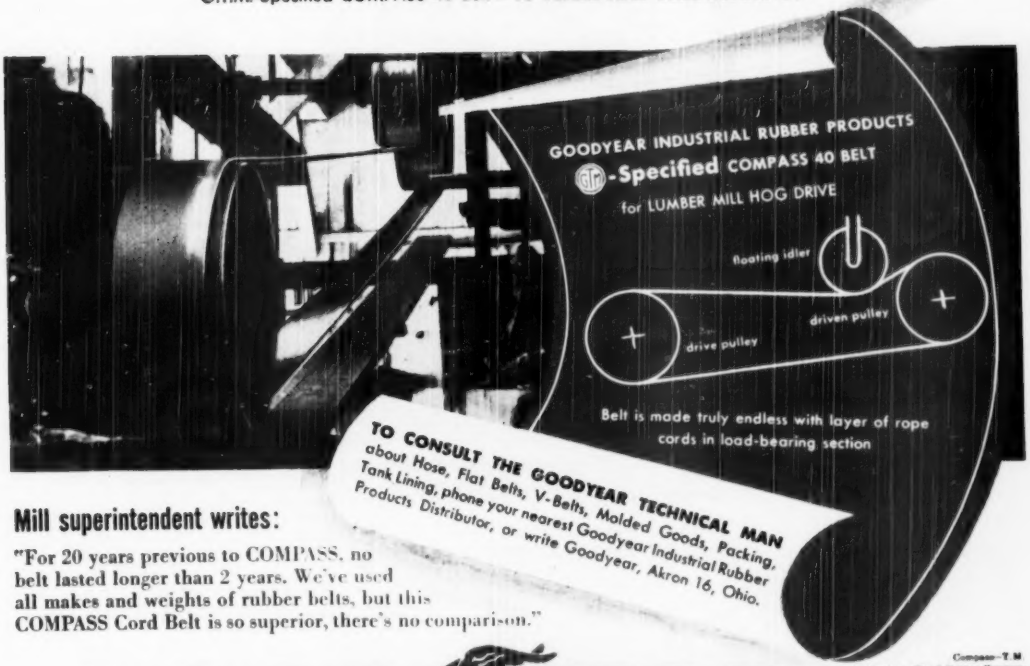
California Lumber Mill reports

8 times longer service

with COMPASS Belt on Hog Drive

Best Previous Belt Service — 2 years

G.T.M.-Specified COMPASS 40 Belt — **16 YEARS AND STILL RUNNING!**


GOODYEAR INDUSTRIAL RUBBER PRODUCTS
G.T.M.-Specified COMPASS 40 BELT
for LUMBER MILL HOG DRIVE
floating idler
driven pulley
drive pulley
Belt is made truly endless with layer of rope cords in load-bearing section
TO CONSULT THE GOODYEAR TECHNICAL MAN
about Hose, Flat Belts, V-Belts, Molded Goods, Packing, Tank Lining, phone your nearest Goodyear Industrial Rubber Products Distributor, or write Goodyear, Akron 16, Ohio.

Mill superintendent writes:

"For 20 years previous to COMPASS, no belt lasted longer than 2 years. We've used all makes and weights of rubber belts, but this COMPASS Cord Belt is so superior, there's no comparison."

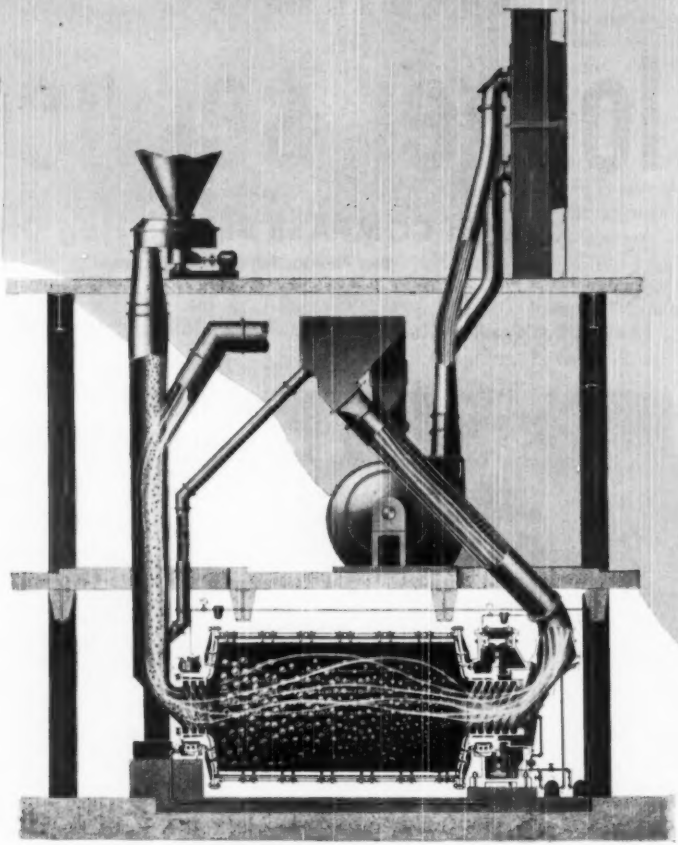
Compass—T. M. The Goodyear Tire & Rubber Company

GOODYEAR

THE GREATEST NAME IN RUBBER

We think you'll like "THE GREATEST STORY EVER TOLD" Every Sunday — ABC Network

KVS AIR SWEPT



KVS offers a complete service in design, building and erecting complete steam generating plants under one responsibility. KVS engineers are available for consultation on your requirements.

TUBE MILLS ...

...for the maximum in fuel value and flexibility of fuel selection

Ability to pulverize any coal... bituminous... anthracite... coke breeze... in any required quantity... means that KVS Air Swept Tube Mills make broad selection of fuel possible. Furthermore, selection can be made on the basis of the fuel which will give the most in value for every dollar expended and hence the lowest cost for each pound of steam generated.

With KVS Air Swept Tube Mills, a superfine product is prepared of "talcum powder" fineness, which is instantly combustible and immediately responsive to combustion controls.

KVS ENGINEERING SERVICE

Ask for a copy of 97-page Engineering Bulletin No. 44-B containing valuable information on preparation of pulverized fuel and steam generating plants.

Kennedy Products — Kennedy-Van Saun Mfg. & Eng. Corp. — New York, U.S.A.

Kennedy-Van Saun

MANUFACTURING AND ENGINEERING CORPORATION

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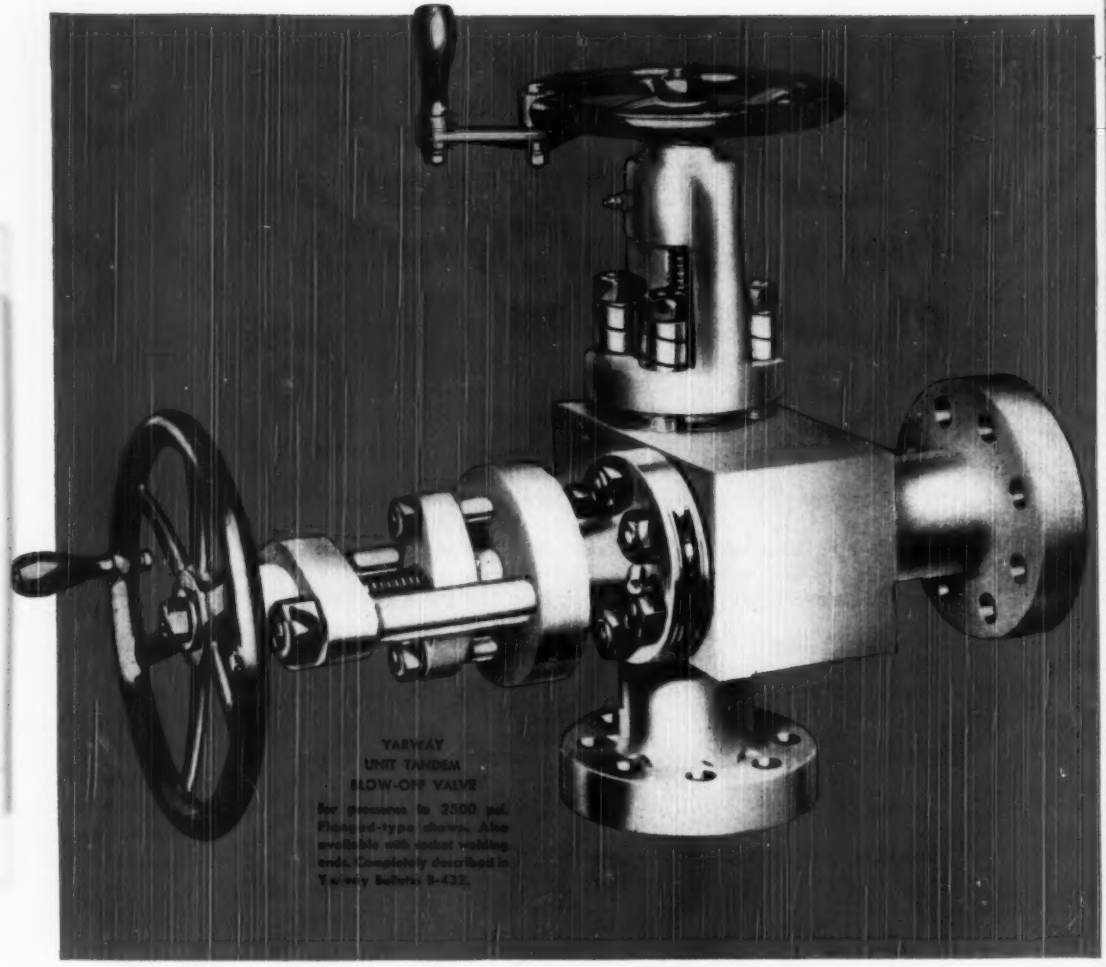
YOUR BOILER



YARWAY

IS WORTH A *GOOD* BLOW-OFF VALVE

Boilers represent sizable investments . . . certainly worth protecting with the most dependable boiler trim you can get.

You need good blow-off valves—valves that keep blow-down lines tight, don't wear, clog or leak, and are rugged enough to stand up under the severe shock of regular or emergency blowing-down under pressure.

Yarway Blow-Off Valves meet those requirements. Both Yarway Seatless Valves with balanced sliding plunger, and Yarway Stellite-faced Hard-Seat Valves embody the most recent developments in design and metallurgy.

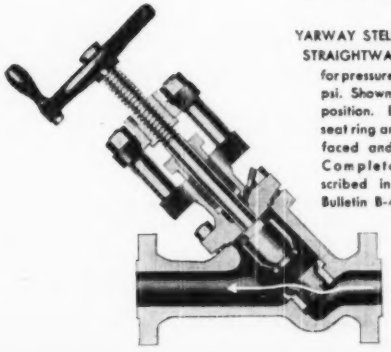
Engineers tell us the sturdiest of all blow-off valves is the Yarway Unit Tandem. This famous valve combines either a seatless and hard-seat, or two hard-seat valves, in a one-piece forged steel body. It is made for pressures up to 2500 psi. Other Yarway Blow-Off Valves meet lower pressure requirements.

It is significant that more than 15,000 plants throughout the world use Yarway Blow-Off Valves . . . and among the higher pressure plants, 4 out of every 5 are Yarway-equipped!

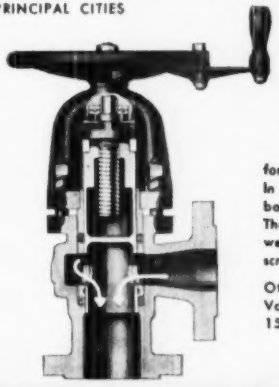
A Yarway bulletin will tell you in detail how these valves can protect *your* boiler investment. Write today, stating pressure range.

YARNALL-WARING COMPANY, 100 Mermaid Avenue, Philadelphia 18, Pa.

BRANCH OFFICES IN PRINCIPAL CITIES

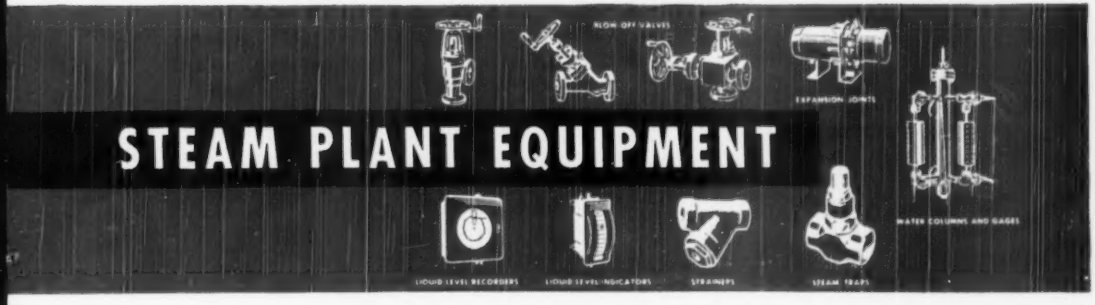


YARWAY STELLITE-SEAT STRAIGHTWAY VALVE for pressures to 2500 psi. Shown in open position. Disc and seat ring are stellite-faced and ground. Completely described in Yarway Bulletin B-432.



YARWAY TYPE "B" SEATLESS ANGLE VALVE for pressures to 400 psi. In open position. Notice balanced sliding plunger. There is no seat to score, wear, clog or leak. Described in Bulletin B-424.

Other Yarway Seatless Valves for pressures to 1500 psi.



"We Saved Valuable Space . . . and reduced the cost of a new panelboard . . . when we installed 400 amp. Fusetron dual-element Fuses instead of 600 amp. ordinary fuses."

"After we were awarded the contract for electrical work in a new ice plant, we discovered that the power distribution panel was far too large for the space allotted to it. This panel was to accommodate two 60 horsepower motors, plus several smaller ones.

"There was only one convenient location, so we refigured the panel size based on using Fusetron Dual-Element Fuses. We reduced the panel sections for the 60 H.P. motors from 600 amp. fuses to 400 amp. Fusetron fuses and reduced the sizes for the other motors in proportion.

"The panel fitted the space easily. In addition to saving the necessary space, the cost of the panel was reduced considerably."

E. H. Brown, Vice President
Sanborn Electric Company
Indianapolis, Indiana

FUSETRON FUSES GIVE 10 POINT PROTECTION

1. Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnout.

FUSETRON

TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION

BUSS

Fusetron DUAL-ELEMENT Fuses

Give All-Purpose Protection

because . . .

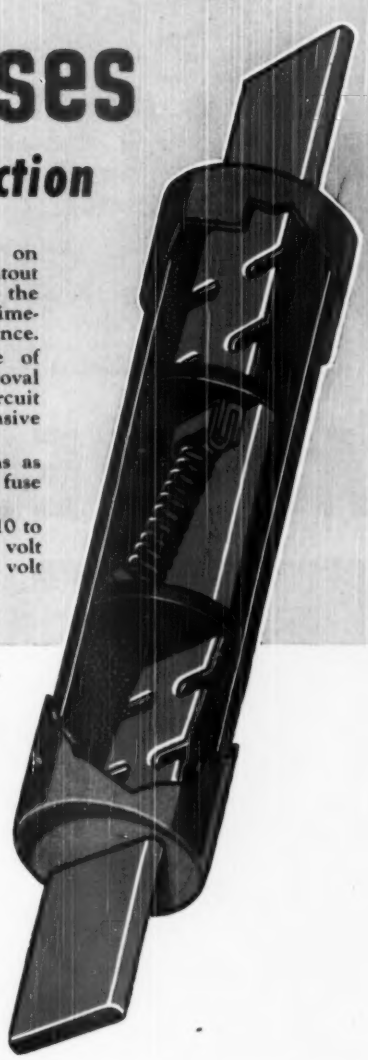
The fuse link element opens on short-circuit — the thermal cutout element protects on overloads — the result, a fuse with tremendous time-lag and much less electrical resistance.

They have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to the same dimensions as ordinary fuses — fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.



DON'T RISK LOSSES

One needless shutdown . . .

One lost motor . . .

One destroyed switch or panel . . .

May cost you far more than replacing every ordinary fuse with a FUSETRON dual-element fuse

MAIL THE COUPON NOW for complete information about Fusetron Fuses and their 10 point all-purpose protection

FUSETRON is a trade mark of the Bussmann Mfg. Co., Division of McGraw Electric Co.

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division of McGraw Electric Co.)

Please send me complete facts about FUSETRON Dual-Element FUSES.

Name .....

Title .....

Company .....

Address .....

City & Zone ..... State 350

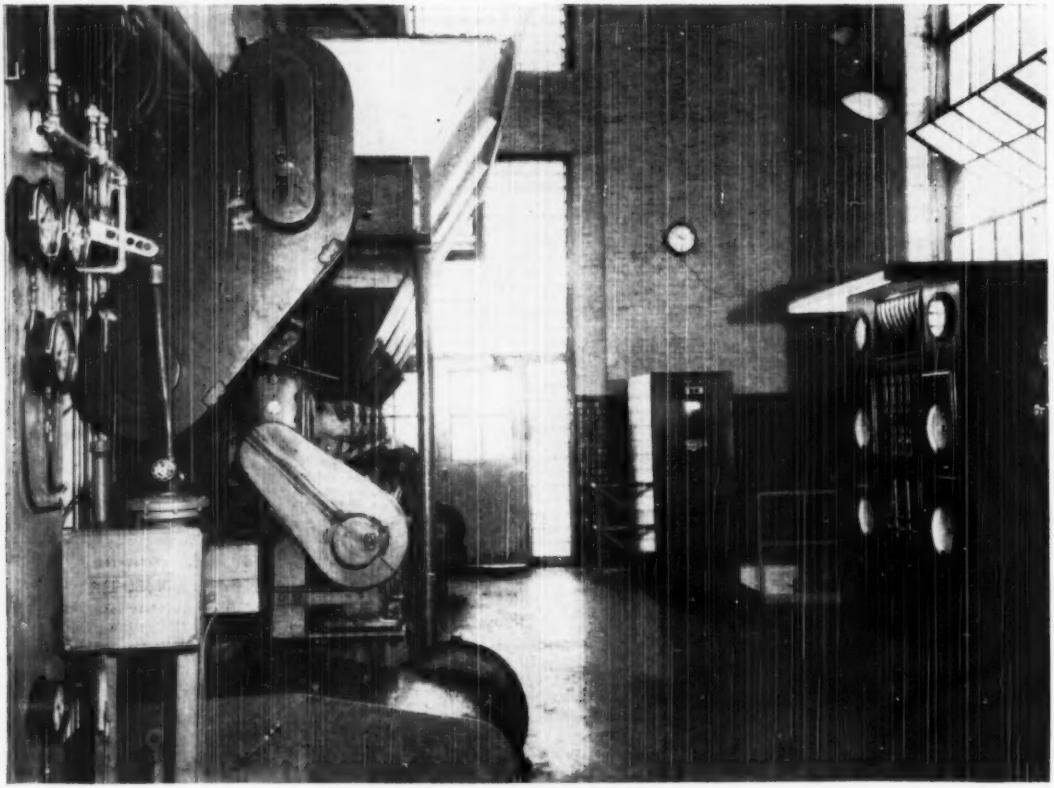
● the Municipal

Electric Light and Power Plant

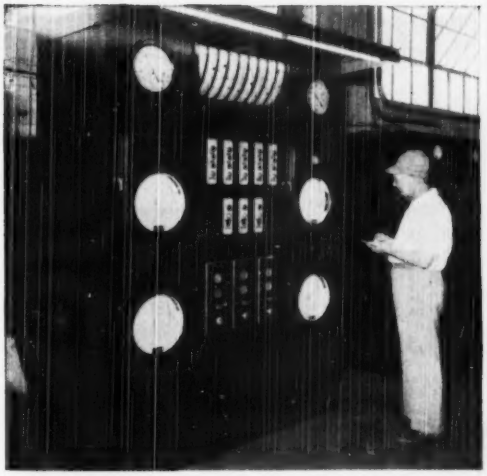
at Hannibal, Missouri

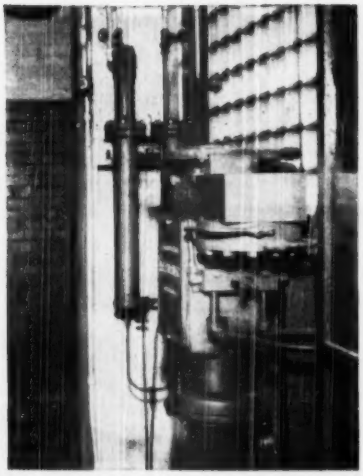
[the home of Mark Twain and his famous characters, Tom Sawyer and Huckelberry Finn]

HAS THE ANSWER TO



View of boiler room showing stokers and Republic boiler instrument and control panel.





Left: All essential boiler records and manual controls are centralized on the Republic boiler panel.

Right: Republic regulator controlling, in measured amounts, the air flow to the boiler.

LOWER STEAM COSTS

A REPUBLIC automatic combustion control system that operates their boiler at test standards, 24 hours a day, is the answer.

Installed at the Hannibal municipal plant is a modern three drum, 90,000 lb. per hour, 400 psi boiler with forced and induced draft fans and fired by a traveling grate spreader type stoker.

The REPUBLIC control system enables them to take full advantage of those economies which have been "built in" their boiler and its auxiliaries. It automatically increases and decreases simultaneously the fuel and air supply to the boiler in the correct amount to maintain constant steam pressure and in the correct ratio to maintain maximum combustion efficiency at all ratings.

The REPUBLIC combustion control system makes and co-ordinates these adjustments automatically, at the same time permits the operator to assume manual control from a centralized control point on the instrument panel whenever advisable.

REPUBLIC combustion control systems are designed and built for all sizes of boilers — all types of fuel firing — all load conditions and any arrangement of draft equipment. We will be glad to supply full information on REPUBLIC Control Systems — just write for Data Book No. S-21.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

YOU CAN BE **SURE**.. IF IT'S
Westinghouse

NEW LARGE INDUCTION MOTOR DESIGN

Cuts Servicing Costs

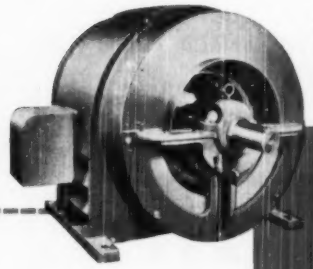
It costs money to wrestle motors. For motors are a long-term investment . . . servicing and inspection are important costs. That's why Westinghouse has introduced a new, radically different, motor design. It makes inspection quick and simple.

Readily accessible split-sleeve bearings reduce inspection to a matter of minutes. There's no top half of the bearing bracket to remove . . . only the top half of the bearing housing. Bearings can be removed, by hand. Light, sturdy end covers and air shields are quickly removable for complete inspection, cleaning or other servicing requirements. They're light—require no crane—can be removed by hand.

Furthermore, installation costs are lowered. New Westinghouse Motors are built of heavy steel, welded to form a rigid unit. The result: motors that are smaller and lighter . . . easier to handle . . . require less space.

These and many other desirable improvements are offered in each of the various enclosure types—dripproof, splashproof or totally-enclosed fan-cooled—frames 30 and larger, squirrel-cage or wound rotor.

Westinghouse engineers will be glad to consult with you at any time. Get the facts now for immediate use or future requirements. Ask your local Westinghouse representative for complete information or write direct. Address: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21553



Shown here is the new **Type CSF** *Squirrel-Cage Motor, Open, Dripproof. There's a Westinghouse Motor for each of the many different power station requirements . . . a right motor for every job.*

Westinghouse

LARGE INDUCTION MOTORS

Take a WALWORTH No. 225P Bronze Valve Apart...

COMPARE IT PIECE BY PIECE

It will pay you to look inside the Walworth No. 225P. Compare the improved design, construction and convenience features shown in the "exploded" view. Notice the husky bronze body, the removable seat and disc, the oversize stem, all assuring maximum protection against wear and leakage.

Further, No. 225P is the TOUGHEST bronze valve your money can buy. The stainless steel, noncorrosive seats and discs are heat treated to a hardness of 500 Brinell — hard enough to scratch glass and crush nails. For this reason, the valve can be closed on sand, slag, scale and similar flotage without injury to the seating surfaces, and "wire drawing" is practically eliminated. Thus years of tight, positive shut-off are assured.

Available in both globe and angle types (angle type: No. 227P) in sizes ¼" to 2", this quality valve is recommended for 350 lbs. W.S.P. at 550 F, and 1000 lbs. non-shock service on cold water, oil, gas or air.

For full data on this long-life, economical Walworth Bronze Valve, see your local Walworth distributor, or write for Circular 82.

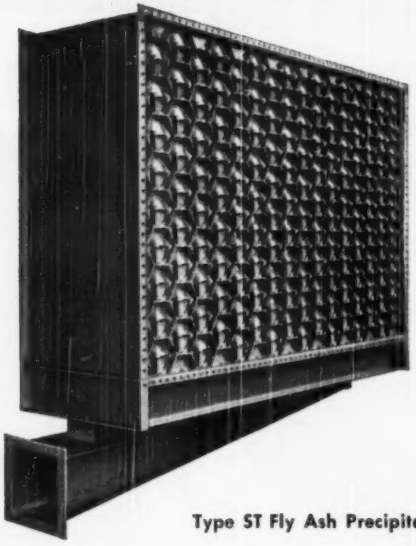
WALWORTH

valves and fittings

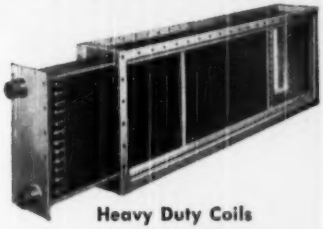
60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

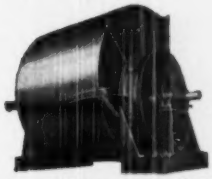
Solve your *fly ash problem* with an AMERICAN BLOWER FLY ASH PRECIPITATOR



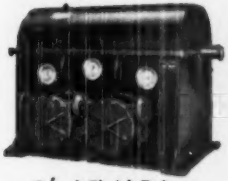
Type ST Fly Ash Precipitator



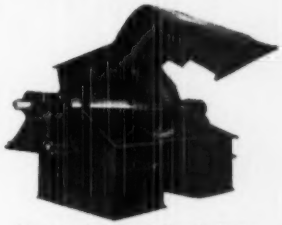
Heavy Duty Coils



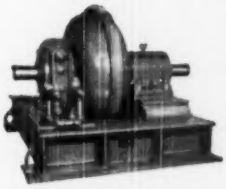
American HS Forced Draft Fans



Gyrol Fluid Drives for Boiler Feed Pumps



Sirocco Induced Draft Fans



Gyrol Fluid Drives for Mechanical Draft Fans

There are many advantages in using American Blower Type ST Precipitators for fly ash problems. Unique in design, simple in operation and low in maintenance cost, these units contribute materially to over-all power plant efficiency.

They automatically maintain high efficiency over the entire boiler load. Even at reduced loads, when fly ash is more difficult to remove, the Type ST Precipitator is relatively more efficient.

In addition, all element cells are die-formed, interchangeable and housed in a single, compact casing. Type ST units are flexibly designed to fit the job. They may be shipped for field assembly, or semi-assembled. They're available in a wide range of sizes to meet a variety of needs.

If you have a fly ash problem, why not call in an American Blower Field Engineer and work your needs out together? He has a wealth of experience behind him and excellent firsthand data at his disposal on Fly Ash Precipitators as well as on American Blower Heavy Duty Coils, Mechanical Draft Fans and Gyrol Fluid Drives for fan control and boiler feed pumps. Simply contact the nearest American Blower Branch Office—conveniently located in all principal cities.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

YOUR BEST BUY AMERICAN BLOWER POWER PLANT EQUIPMENT

Serving home and industry

AMERICAN-STANDARD · AMERICAN BLOWER · CHURCH SEATS · DETROIT LUBRICATOR · KEWANEE BOILERS · ROSS HEATER · TONAWANDA IRON

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OIC
PACE SETTER IN VALVES

Engineered FOR LASTING SERVICE

200 LB. UNION BONNET BRONZE GATE VALVE

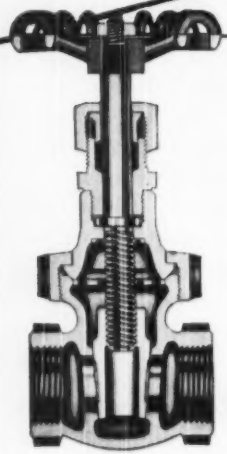
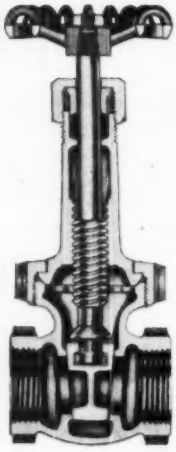


FIGURE NO. 7208 Non-rising stem, integral seat, OIC nickel alloy solid wedge, screwed end type.

FIGURE NO. 7200 Rising stem, integral seat, OIC nickel alloy solid wedge, screwed end type.



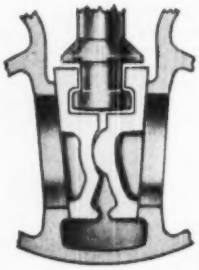


FIGURE NO. 7202 OIC Nickel Alloy double taper wedge automatically adjusts itself to its seat as valve is closed.

DESIGN: Solid wedge, rising stem; double-tapered wedge, rising stem; or solid wedge, non-rising stem. Integral seat, screwed end design.

BODIES: Of Steam Bronze ASTM B61, with average tensile strength of 40,000 lbs.

BONNETS: Also of Steam Bronze, with seal on lower end which mates with corresponding surface on stem to allow valve to be packed while fully open and under pressure. Condensing chamber below the stuffing box to keep packing cooler on high-temperature lines.

GATES: Of two types.

SOLID WEDGES are OIC copper nickel alloy, are of I-beam design, and reversible.

DOUBLE-TAPERED WEDGES fit into same bodies, but have ball and socket design, allowing wedge automatically to adjust itself to seat as valve closes. Accurately machined guides on both types, and tapered seating surfaces to give full contact with body seats as the wedges wear.

STEMS: Of manganese bronze, with double Acme thread for quick traverse of the wedge. Diameters sufficient to bear torsional loads greater than strongest hand pressure and to withstand severe operating conditions.

SEATING SURFACES: Machined to five-degree, self locking angle.

HANDWHEELS: Of ventilated malleable iron, finished in black enamel.

RATINGS: For steam at 200 lbs., 550 degrees F.; for cold water, oil, or non-shock gas service at 400 lbs. Shell tested at 500 lbs. and seat tested at 400 lbs.

SIZES: One-fourth inch to three inches currently available.

Special **INTRODUCTORY OFFER**

Check this 200-lb. Union Bonnet Bronze valve. Send us the size, and we'll deliver you a sample on memo billing. Keep it 30 days, take it apart, analyze it, test it. After you've examined all its superiorities, you may return it, if you wish, for full credit.

OIC VALVES

THE OHIO INJECTOR CO.
221 MAIN ST., WADSWORTH, OHIO

BRONZE • CAST STEEL • FORGED STEEL • IRON

0-1149-33

TRI CLAD MOTORS
REG. U.S. PAT. OFF.
will run safely without relubrication for as long as any general-purpose motor you can buy—
and if the application makes relubrication a must, you can grease a TRI CLAD without halting production
GENERAL ELECTRIC
HERE'S WHY

TRI CLAD MOTORS will run safely without relubrication for as long as any general-purpose motor you can buy—

Tri-Clad extra lubrication "protection" can save you money because:

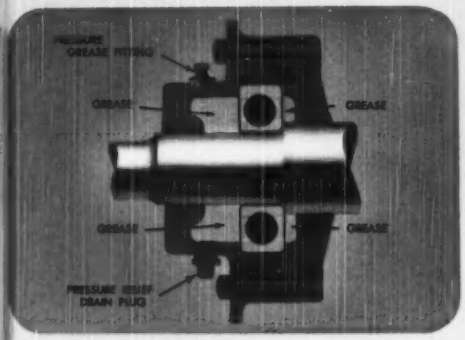
1. Tri-Clad's oversize grease reservoir and the heaviest standard-service bearings mean you do not have to bother with greasing between motor check-ups.

2. When relubrication is needed on those tough applications, you can grease a Tri-Clad without interrupting production-line operations.

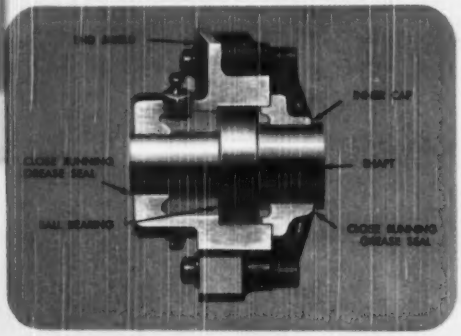
Tri-Clads are grease-gun easy to lubricate *on the job*. Moreover, a Tri-Clad motor will run safely where an ordinary motor would fail. Chances are you'll be spared the cost of a "special" motor.

YOU BE THE JUDGE! The best way to prove to yourself that Tri-Clad gives you the most for your motor dollar is to contact your local G-E office. Tri-Clad stocks are complete. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

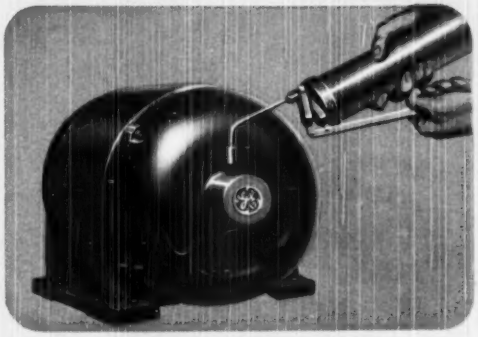
1 **EXTRA BEARING PROTECTION** — Tri-Clad gives you extra bearing protection because heaviest standard-service bearings are carefully selected to withstand severe loads for long periods.



2 **EXTRA GREASE** — Four times the ordinary amount of grease is packed into the large Tri-Clad grease reservoir. Since bearing life depends on grease, this means that Tri-Clad motors will run safely for years — for as long as any general-purpose motor you can buy.



3 **SEALED-IN BEARINGS** — Bearings and grease are completely sealed in a cast housing with long running seals for extra protection from dirt, dust, and lubricant leakage.



4 **PRESSURE-RELIEF GREASING** — An efficient system of pressure-relief lubrication (with standard fittings) enables a Tri-Clad motor to be quickly and easily greased on the job when and if it's needed.

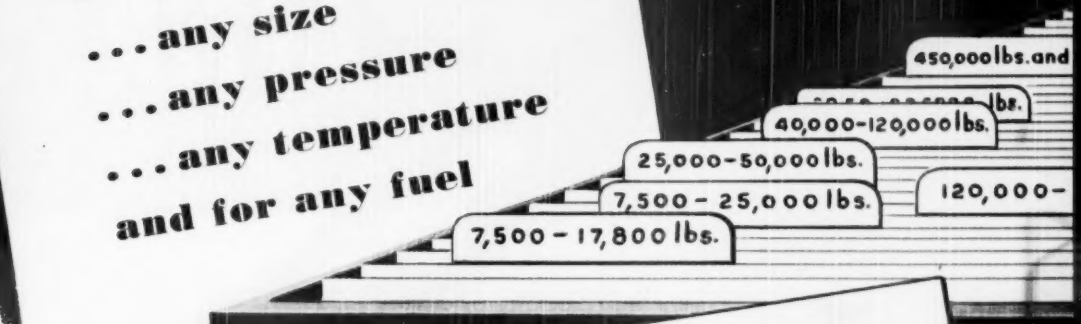
GENERAL ELECTRIC

752-3

SPRINGFIELD

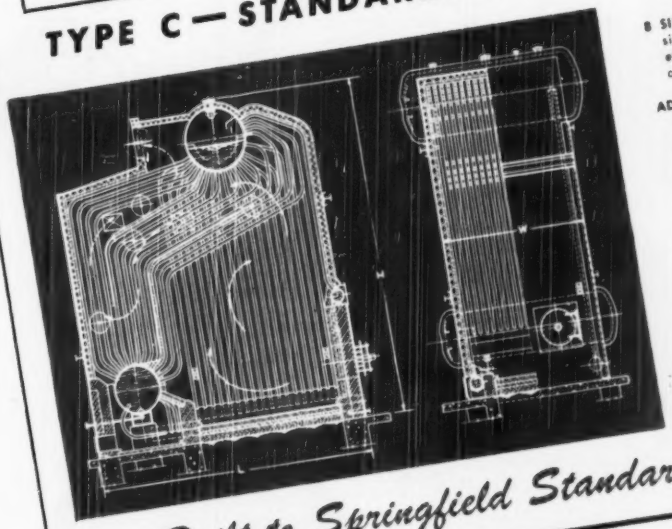
BOILERS
to meet your needs!

...any size
...any pressure
...any temperature
and for any fuel



10,000 – 45,000 lbs. Capacity

TYPE C — STANDARDIZED 2-DRUM BOILERS



SIZES — Springfield offers small to medium size plants a wide choice of modern, efficient steam generating units in its line of Type C 2-drum boilers.

ADVANCED DESIGN — Dry steam — steam delivery tubes discharge above water level; positive circulation, high reliability, low maintenance. Standardized construction permits quicker delivery, maximum economy — yet readily adaptable to modification to meet user's particular requirements.

WATER-COOLED FURNACE — Furnace is completely water-cooled in sizes of 20,000 lbs. and over. Superheater, air heater, and economizer, if desired.

OIL, GAS, OR COAL — Built for firing with standard oil or gas burners, spreader or underfeed stokers. See your local Springfield representative, or write.

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See our catalog in SWEET'S

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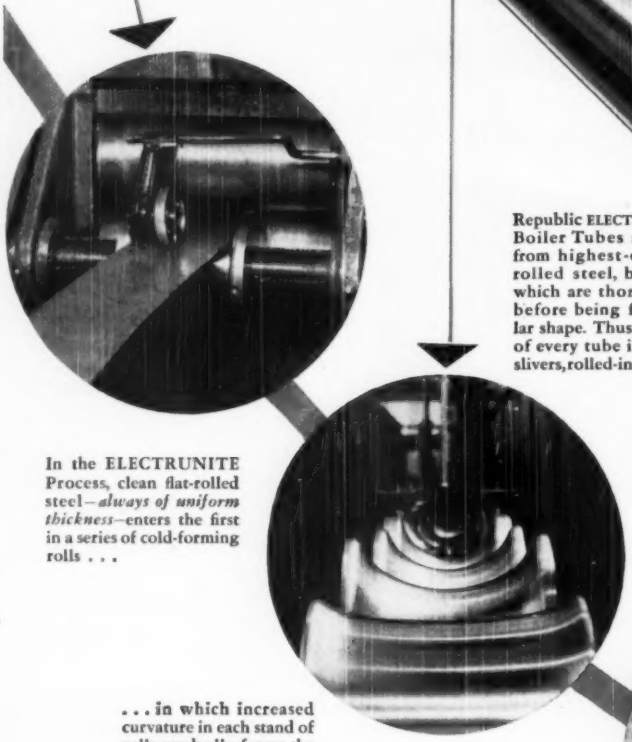
BEFORE... *and* AFTER...

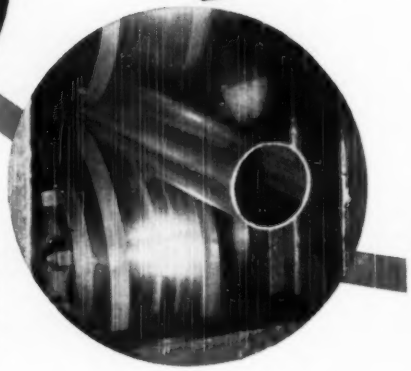
Republic ELECTRUNITE Boiler Tubes are made from highest-quality flat-rolled steel, both sides of which are thoroughly inspected before being formed into tubular shape. Thus, the inner surface of every tube is free from scabs, slivers, rolled-in scale and scale pits.

In the ELECTRUNITE Process, clean flat-rolled steel—*always of uniform thickness*—enters the first in a series of cold-forming rolls . . .



. . . in which increased curvature in each stand of rolls gradually forms the flat steel into uniformly round tubular shape . . .

. . . after which it is welded by Republic's improved electric resistance welding process, and emerges in the form of uniformly strong, sound tubing.



ELECTRUNITE BOILER TUBES ARE

Clean...Scale-Free

INSIDE AND OUT

THE very nature of the modern ELECTRUNITE PROCESS means that there's a big difference between Republic ELECTRUNITE Boiler Tubes and those made by other methods of manufacture.

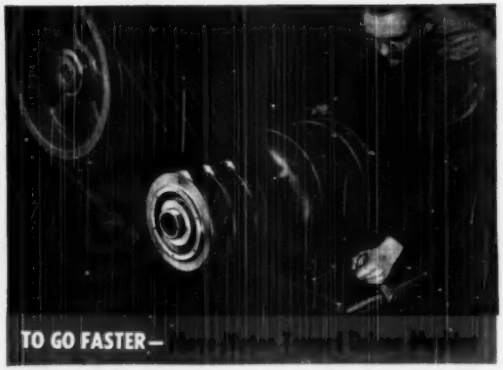
In the ELECTRUNITE Process, highest quality flat-rolled steel is cold-formed into shape and electrically welded into strong, sound tubing. *Careful visual inspection* of the flat surface which becomes the inside wall of each tube provides positive proof that there are no hidden defects or trouble-inviting pits in the wall. Each length of ELECTRUNITE Tubing is smooth and clean, *inside and out*—uniformly strong and sound throughout its entire length.

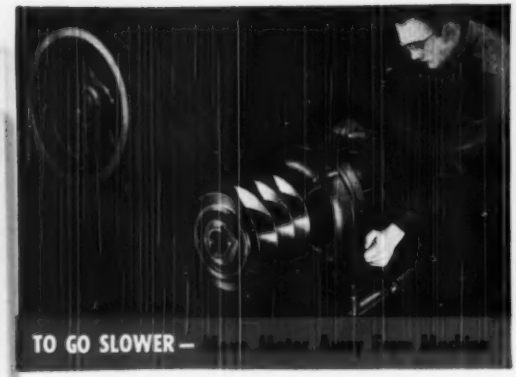
Yet, thorough visual inspection is but one of the many rigid testing and inspection procedures which are a vital part of the ELECTRUNITE Process. Expansion tests . . . crush tests . . . hydrostatic pressure tests . . . all combine to give you the fullest possible assurance of dependability and satisfaction when you use ELECTRUNITE—the *original* resistance welded boiler tube.

For complete information, including a list of sizes, gages and analyses—or prompt technical assistance on a specific tubing problem, write, wire or phone *today*.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, New York

Vari-Pitch
AUTOMATIC
SHEAVE





TEXROPE *offers Instant, Low Cost Way to*

Control Machine Speed

- Covers most speed changing applications from 1½ to 40 hp.
- Very simple — one sheave does everything automatically.
- Infinitely variable speed—100% increase; 2 to 1 range.

NOW YOU CAN HAVE all the advantages of instant speed control on all your machines at very low cost and without installing intricate and expensive mechanisms. You can increase production by setting operating speeds at exactly the right tempo for highest production. You can improve quality, change to new materials, all at the twist of a wrist.

All this is made possible by the *new Vari-Pitch* Automatic Sheave which changes pitch diameter and holds proper belt tension *automatically*. Today, ask your A-C Authorized Dealer or Sales Office to give you complete facts and figures on how the new *Vari-Pitch* Automatic Sheave can save money in your operations. Or write for Bulletin 20B7223. A-2837

ALLIS-CHALMERS, 952A SO. 70 ST.
MILWAUKEE, WIS.

Texrope and *Vari-Pitch* are Allis-Chalmers trademarks.

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

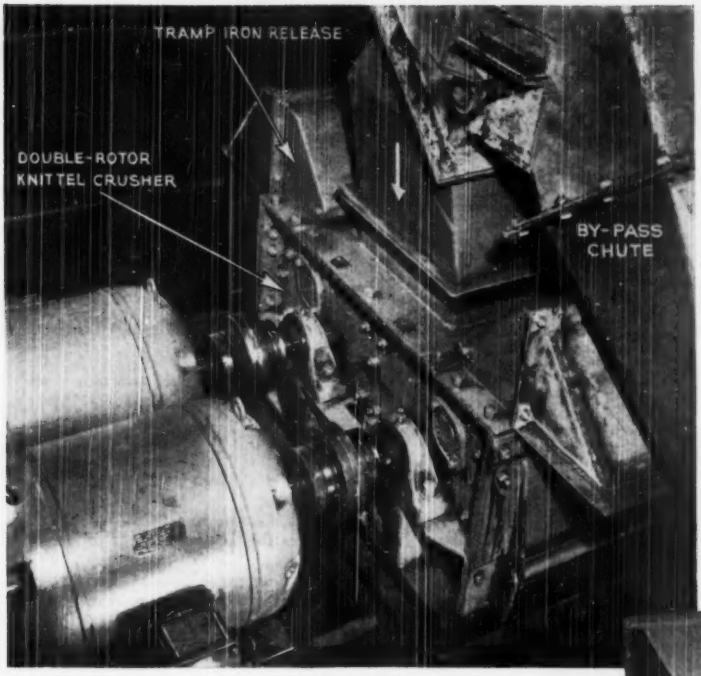
MOTORS — ½ to 25,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

PUMPS — Integral motor and coupled types. Sizes and ratings to 2500 GPM.

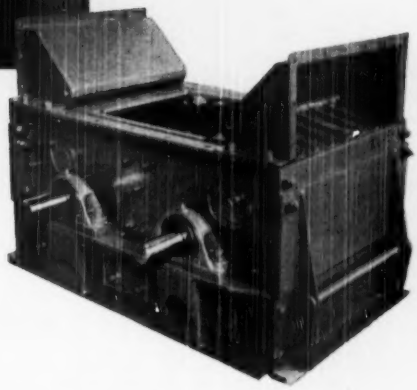
ALLIS-CHALMERS

A-C



At a large midwestern paper mill, wet fine coal was a serious problem since it was cutting crusher capacity down by 50 per cent. A double-rotor KNITTEL crusher with two 18"x18" rotors was installed and tripled the crushing capacity . . . 63 TPH continuously and without difficulty from clogging.

With this new S-A design, two rotors operate independently, each from a separate motor, yet no additional horsepower is required. Rotors and rings are spaced far enough apart to just clear each other when in operation. Whirling gangs of rings crush lumps as they fall through crusher. Breaker plate is eliminated and there is no stationary surface on which wet fines can collect. Foreign material is ejected through tramp metal openings without stopping crusher.



S-A Develops New "Clog-Proof" Double-Rotor KNITTEL Crusher for Crushing Wet Coal

Crushes Lumps, Passes Fines Continuously with no Build-up or Plugging of Crusher Throat

Good news for power plants today centers around the announcement by Stephens-Adamson engineers of a new S-A Double-Rotor KNITTEL (ring-type) crusher that crushes wet coal without clogging.

Clogging of crusher throat has always been a serious problem when a large percentage of wet fines are present. Wet coal tends to build up on the breaker plates resulting in choking, lost time and ineffective use of power. With this new S-A Double-Rotor KNITTEL Crusher, clogging problems are eliminated.

For more than half a century S-A engineers have been making major improvements in coal and ash handling equipment and systems. So, take advantage of these years of experience. Before you decide on any changes in your present system, get the recommendations of S-A engineers. There is no obligation on your part for this service. Write today!

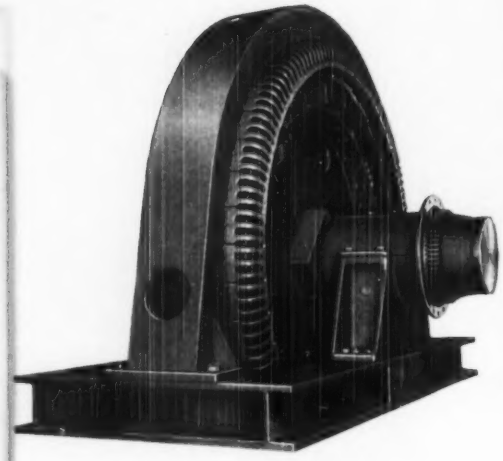
STEPHEN S-A DAMSON MFG. CO.

5 Ridgeway Avenue, Aurora, Illinois · Los Angeles, Calif. · Belleville, Ontario

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT

Save on original costs

use G-E synchronous

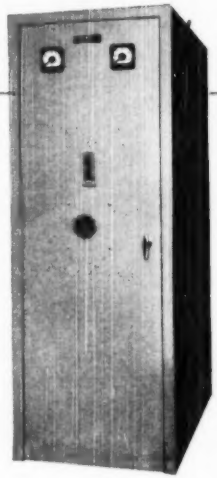


You'll save money in many applications when you specify General Electric synchronous motors. The chart shows (ratings above the black line) the applications where synchronous motors (including control and exciter) have a lower first cost than any other kind of motor. And even in cases where there is no original saving (between red and black lines) you can save on over-all cost by specifying synchronous motors to increase operating efficiency and improve power factor.

When you specify G-E synchronous motors, you get application engineering by experts in the electrical problems of *your* industry. You get the motor that gives you greatest return on your investment.

For your next large, constant-speed motor, ask your General Electric sales representative to tell you how you can take full advantage of the money-saving features of G-E synchronous motors. Or write for bulletins on your letterhead to *Section 770-17, Apparatus Dept., General Electric Co., Schenectady 5, N.Y.*

Low speed..GEA-5332 **High speed..GEA-5426**
Control..GEC-505



PROTECT YOUR SAVINGS WITH G-E SYNCHRONOUS MOTOR CONTROL

New rotor field circuit provides accurate field application—motor is protected against starting shock.

New rotor field circuit keeps constant check on motor performance and, on pull-out, field is removed before first slip cycle is completed—to protect against electrical and mechanical damage.

In addition to the protection offered by the new rotor field circuit, the **new, smaller air-break Limitamp controller** provides fast-acting EJ-2 Fuses that limit short circuits to less than one-half cycle for motors up to 5000 volts.

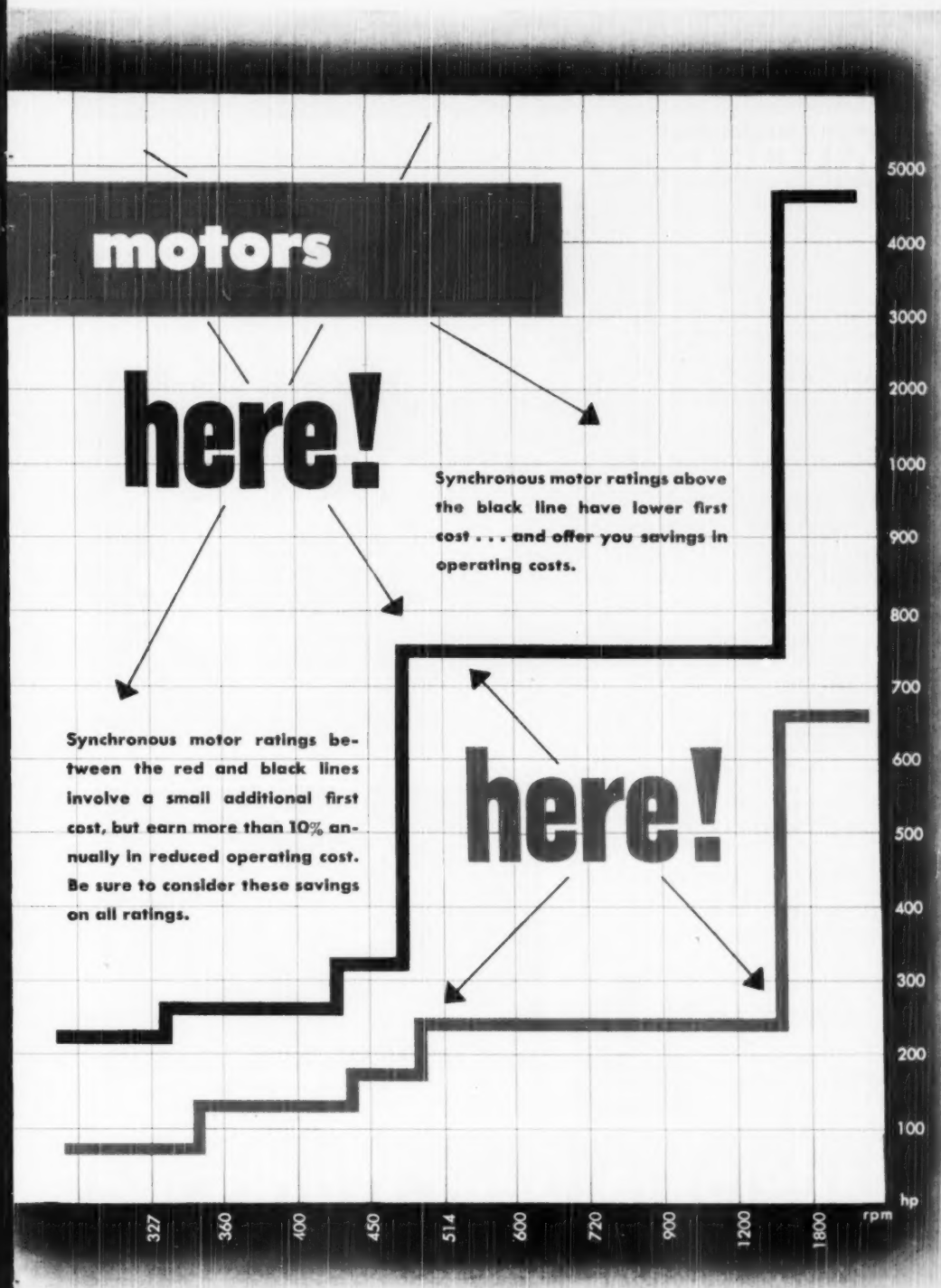
Low-voltage motors (up to 600 volts) are protected by compact, easily inspected air-circuit breakers.

To make it easier to install, to adjust, to operate, and to service, G-E synchronous control is factory-mounted in a steel enclosure with anti-glare meters and all the built-in accessories required for your application.

Come to General Electric for the engineering and manufacturing that will assure you of adequate protection of your motor and plant investment. Write for more information on this precise motor control.

GENERAL ELECTRIC

770-17


motors
here!
Synchronous motor ratings above the black line have lower first cost . . . and offer you savings in operating costs.
Synchronous motor ratings between the red and black lines involve a small additional first cost, but earn more than 10% annually in reduced operating cost. Be sure to consider these savings on all ratings.
here!
5000
4000
3000
2000
1000
900
800
700
600
500
400
300
200
100
hp
327
360
400
450
514
600
720
900
1200
1800
rpm

SEWAREN GENERATING STATION—*Uses..*

(Public Service Electric and Gas Company)

LIMITORQUE VALVE CONTROLS

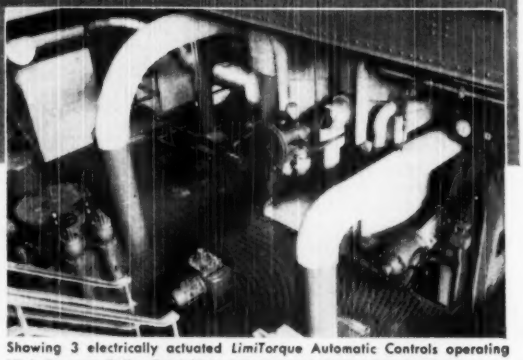
—*because they're* DEPENDABLE,

Safe, Accurate and Trouble-Free

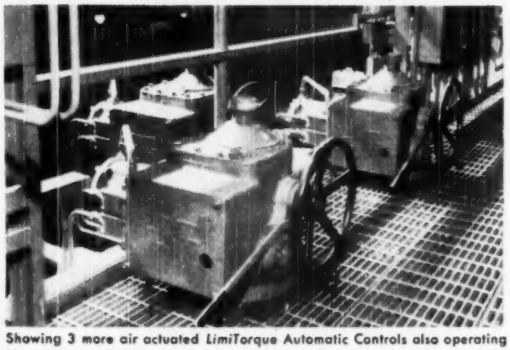
We are very appreciative of the fact that this large, modern Central Station has (like many other modern stations throughout America) installed *LimiTorque Automatic Valve Operators* for their high pressure Boiler Feed Lines, and for sluice gate actuation.

LimiTorque Remote Control enables one man to merely "push buttons" and actually see on a panel-board whether the valves are open or closed. Then too, there is the important safety factor afforded by *LimiTorque Remote Control,* because men do not have to go to high, low, dangerous or inaccessible locations to open and close valves. Further, *LimiTorque* prevents damage to seats, discs, stems, etc., because it "automatically" shuts-off the power, should an obstruction in closing occur.

LimiTorques are available for different requirements on all types of valves (globe, gate, butterfly, plug, etc.) —and may be supplied for actuation by any power source, such as electricity, steam, water, gas, oil or air.



Showing 3 electrically actuated *LimiTorque* Automatic Controls operating High Pressure Boiler Feed Valves at Sewaren Generating Station.



Showing 3 more air actuated *LimiTorque* Automatic Controls also operating High Pressure Boiler Feed Valves at Sewaren Generating Station.

Thousands of *LimiTorques* are in use throughout the world, on land and sea. Be convinced; send for our 96-page catalog, L-48, and please use your Business Letterhead when requesting same.

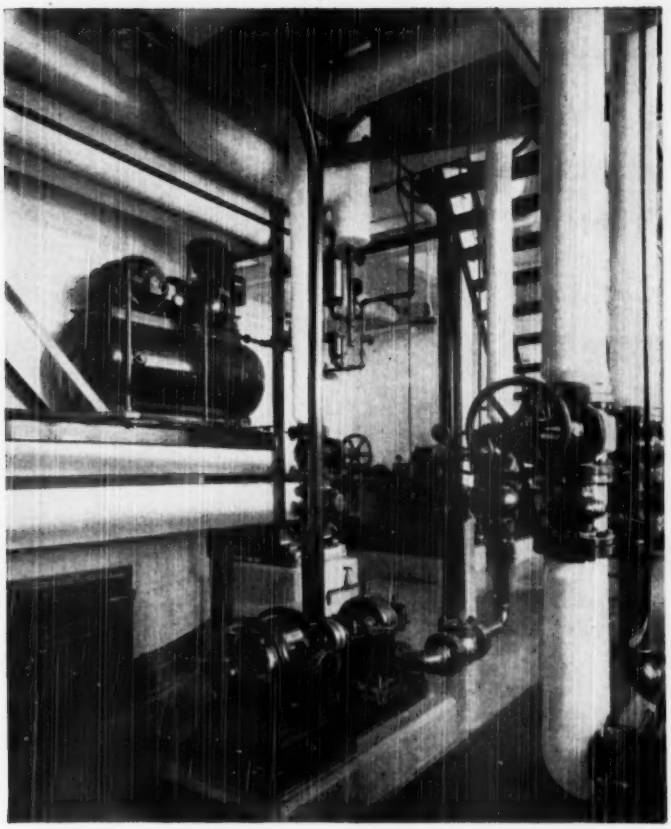
Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON

IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls



Pratt & Whitney's 14-mile K&M insulation starts here. It's fit for the job and looks fit!

Where K&M "*Featherweight*"® 85% Magnesia

Keeps up steam...keeps down cost...for 14 miles

Pratt & Whitney Division of Niles-Bement-Pond Company, West Hartford, Conn., has long been noted for fine machine tool, cutting tool and precision gauge manufacture. The scientific attitude is a Pratt & Whitney habit. They applied it to saving b. t. u.'s along 14 miles of steam lines throughout their large power plant and shops. That led them to use K&M "Featherweight" 85% Magnesia pipe insulation for maximum efficiency and permanence.

The inherent insulation effectiveness of K&M "Featherweight" 85% Magnesia comes from basic Carbonate of Magnesia. This is combined with clean Asbestos Fibre in correct proportion for needed weight-saving strength. Therefore it is easy to do a fast, shipshape insulation job whose continued efficiency does not depend on costly maintenance.

Designed for temperatures to 600° F., K&M "Featherweight" 85% Magnesia comes in all standard sizes. Like the other K&M insulation materials, it can save you waste—difficulty—money. Get help on any points by consulting your nearest K&M Distributor—an insulation expert.

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SAVE WEIGHT
SAVE SPACE
and get higher
EFFICIENCY
IN . . .

MECHANICAL *DUST* COLLECTION

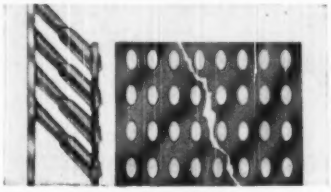
These three highly important characteristics are an integral part of the Aerotec Design 3 RAS . . . one of the most outstanding developments in the art of mechanical dust collection.

Small (3 inch diameter) tubes, provide an increased centrifugal force, yield maximum efficiency, with a particularly high efficiency on the ultra-fine dusts. Improved ramp tube inlet design promotes closer nesting of the tubes with consequent conservation of space.

Permanent mold casting insures closer tolerances and the smooth interior precipitating surface required for extremely high efficiencies and clean operation. The use of aluminum reduces weight from 40% to 45% compared to conventional materials, with consequent reductions in supporting structure.

Aerotec Design 3 RAS collectors, assembled at the factory into 60 tube building block units, offer all the advantages of standard stock units, with the flexibility of a "tailor made" installation, since these blocks may be assembled into many combinations of width and height to fit available space.

A request will bring you the latest bulletin on Aerotec Design 3 RAS.



The basic unit building block, combinations of which are used to tailor the Design 3 RAS collector to any capacity or dimension required.

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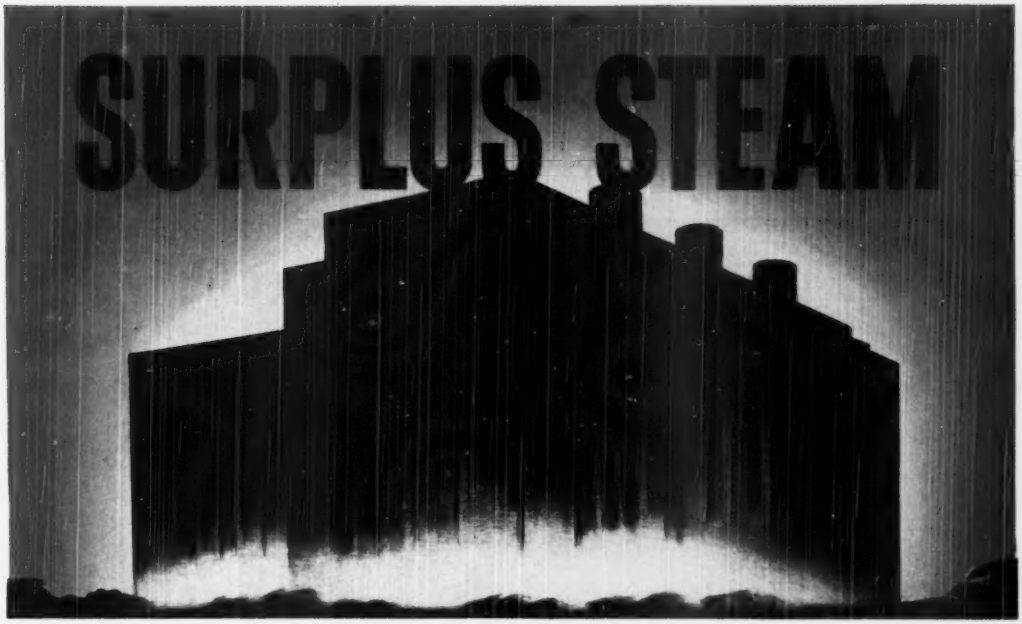

INTO THE AIR...OR INTO PROFITS?

Power generating stations are usually so located that their exhaust or excess steam can be readily converted into attractive profits—As a result, many municipal and industrial plants, large and small, are creating new incomes today by providing BTU services to adjoining industrial, commercial, and residential districts.

Hundreds of existing heating systems of Ric-Wil Hel-cor Insulated Piping are delivering billions of pounds of this "ready-made" heat annually to thousands of users.

Ric-Wil Insulated Piping Systems are engineered and prefabricated to fit specific installations, constructed with "built-in" endurance and maximum thermal efficiency.

Your plant may have a perfect set-up for converting your exhaust or excess steam into good profits. Why not talk it over with a Ric-Wil representative, who will call at your convenience, and at no obligation to you.

For full technical information on Ric-Wil Insulated Piping Systems, call or write the Ric-Wil office nearest you or Dept. 5-K in Cleveland, Ohio.

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SERIES 12100*

FORGED STEEL

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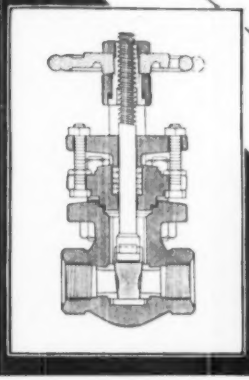
150-800 POUND

GATE VALVES

SIZES 1/4" to 2"



***Series 12100**

CARBON STEEL } 800 Pounds @ 750° F.
1500 Pounds Cold Non-Shock

For 150-800 pounds service • Round Bolted Bonnet • Bolted Gland • Gasket or Ground Joint • Outside Screw and Yoke • Renewable Seat Rings • Solid Wedge — Slotted Type • Rising Stem 11½-13% Chrome Stainless Steel Trimmings • Sizes 1/4" to 2" inclusive.

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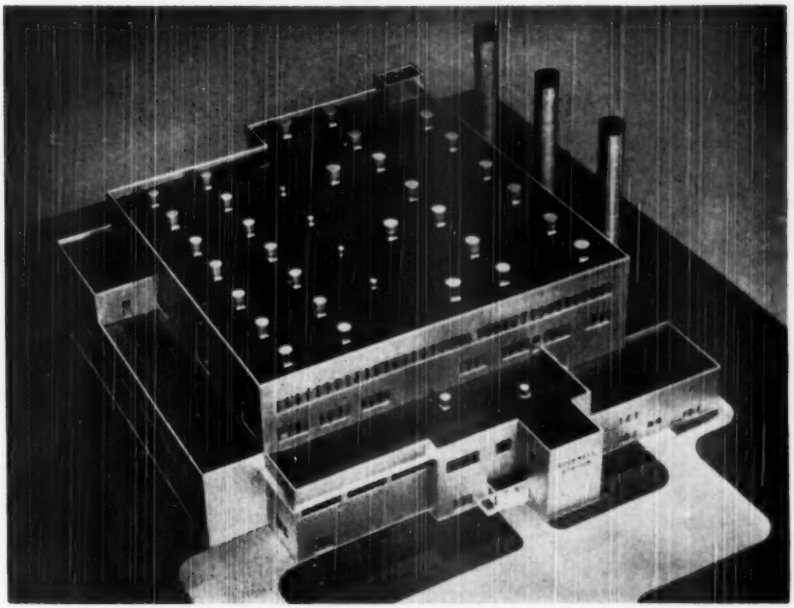
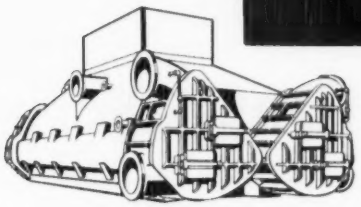
NEW PHILIPPINE STATION
to install two I-R condensers



A model of the new Rockwell Station which was designed as a low building to withstand earthquakes and high wind velocities. The Ingersoll-Rand low headroom "Twin" condenser was ideal for this low type of building.

The building is completely covered with aluminum, backed by a layer of glass wool and flat steel plate which is welded to the girts.



Ingersoll-Rand "Twin" condensers have given many new power plants the advantage of unusual economy in space and foundation requirements. Installation costs are further reduced because "Twin" condensers can be tubed in the shop, and each half can be shipped completely assembled.

Other Ingersoll-Rand equipment for the station:

Boiler-feed pumps
Circulating water pumps
Condensate pumps
Miscellaneous plant service pumps

Manila Electric Company's new 50,000-Kw power station will be served by two complete I-R Condensing Plants

Rehabilitation and expansion of the power generating facilities of the Manila Electric Co. has already reached the point where 98% more power is being furnished than before the war. War damaged equipment is being repaired; a 30,000-kw floating power plant has been leased from the U. S. Government and a new 50,000-kw power station, designed by Gilbert Associates, Inc., is being erected in the municipality of Makati.

Here there will be two 25,000-kw turbine-driven generators, each served by a *complete Ingersoll-Rand Condensing Plant*. Also, Ingersoll-Rand boiler-feed pumps will serve three oil-fired boilers, each with an evaporating capacity of 250,000 lb per hour at 850 psi, 910° F.

Manila Electric Co. has spared no effort to restore their electric service to more than pre-war standards and this selection of Ingersoll-Rand condensers and pumps will help insure the best in over-all plant operating economy.

When you expand your power-generation facilities, it will pay you to investigate the many new developments in Ingersoll-Rand equipment.

Compressors • Condensers
Turbo Blowers • Centrifugal Pumps
Rock Drills • Air Tools • Oil and Gas Engines

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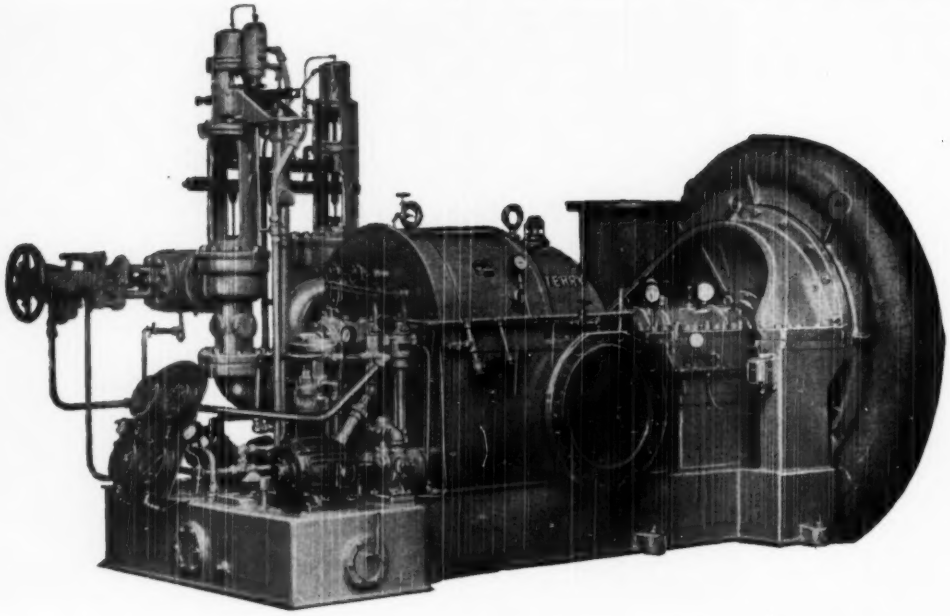
The TERRY TURBINE



SPECIAL PURPOSE TURBINE

FOR OPERATION UNDER ALL THESE CONDITIONS:

1. Straight, high-pressure, condensing
2. Straight, low-pressure, condensing — putting to work excess low-pressure steam.
3. Mixed pressure — using the low-pressure steam available, with only enough high-pressure steam required to drive the compressor
4. Condensing bleeder operation — providing clean, low-pressure steam for heating or process work

. . . and the speed under any of these conditions can be varied from 2800 to 4750 rpm.

This is but one example of many unusual combinations developed by Terry to meet out-of-the-ordinary requirements in turbines up to 2000 hp. Information on a special-purpose turbine for your specific requirements will be gladly furnished.

T1177

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

PRIMING OR FOAMING?

Carryover is a tough problem that you can't argue, or guess, out of existence. It can cause serious mechanical, operating and processing difficulties, ranging from damage to process materials to deposits on high pressure turbine blades. To know the cure, you *must* first know the cause. The chief causes of carryover are priming and foaming.

Priming, the *mechanical* entrainment of boiler water in steam, is caused by "belching" or surging. Its correction usually involves *mechanical* considerations, such as operating and design modification.

Foaming, the entrainment of boiler water in steam, is caused by build-up of foam. It results from high alkalinity, high dissolved and suspended solids, oil contamination, etc. Correction of foaming usually involves *chemical* considerations, such as proper control, anti-foam treatments, etc.

The Drew System of Water Treatment eliminates guesswork! It starts with proper diagnosis. It includes recommendations for corrective treatment and other preventive measures, such as modification of operating cycles and redesign of equipment, if required. It is specialized service applied to your individual boiler problem.

Don't gamble with guesses! Consult the Drew Engineer or write for further information on carryover and other water problems.

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Nationwide service in Boiler Water and Cooling Water Conditioning

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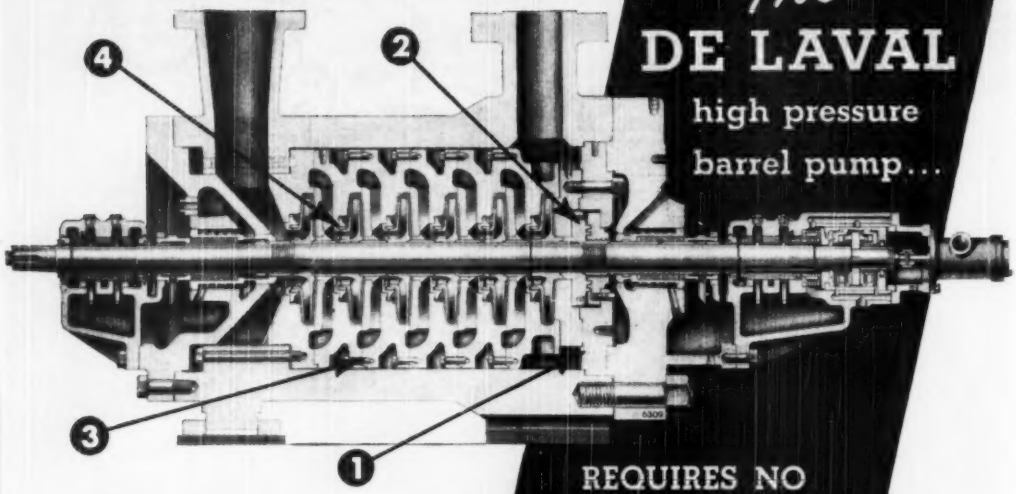

The DE LAVAL high pressure barrel pump...

REQUIRES NO SLOW PRE-HEATING

The De Laval barrel type boiler feed pump is designed to meet the exacting requirements of modern, fast-steaming, high pressure, central stations. When sudden load changes call for water in a hurry this pump can be thrown on the line quickly without slow pre-heating.

Inspect the above drawing and you'll see how the pump has been designed to minimize the effect of sudden temperature change.

1. **INNER ASSEMBLY** completely free to expand independently of outer barrel.
2. **AUTOMATIC HYDRAULIC BALANCING DEVICE** with radial throttle balances all axial thrust completely and automatically — unaffected by temperature change.
3. **INDIVIDUAL BOLTING OF DIAPHRAGMS** lessens temperature strains.
4. **LARGE CLEARANCE LABYRINTH WEARING RINGS** have ample tolerance for thermal expansion. Action of these rings does not depend upon maintenance of close clearances.

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CENTRIFUGAL PUMPS • WORM GEAR SPEED REDUCERS • IMO OIL PUMPS

POWER

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COVER PHOTO: Driven by two 25,000-hp Westinghouse motors in tandem, aluminum-bladed axial compressor will push air at 840-1500 mph through NACA's wind tunnel at Ames Aeronautical Lab., Moffett Field, Calif.

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Industry's *new* steam drive

Here's the new general-purpose turbine that meets the increasingly rigid demands of modern industry. Wrapped up in one *standard* unit are the best features of previous Westinghouse drives . . . plus important refinements and new developments, including features formerly obtainable only as costly "specials".

The new "Type E" is designed to operate reliably and efficiently where the going is tough. It's built to give trouble-free, economical performance for long periods of continuous operation . . . or instant operation when used as a standby drive . . . regardless of operating conditions.

Weatherproof bearing seals, corrosion-resisting gland zones, centerline support for freedom of expansion and contraction, dual protection against overspeed, floating movement of governing and trip linkages, and parts interchangeability between wheel sizes are among the many advantages built into the new Type E drives.

We invite your comparison. For the full story, call your nearby Westinghouse office. Ask for the "Type E" Turbine book B-3896, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna. J-50498

Westinghouse TYPE E Turbines

YOU CAN BE **SURE**.. IF IT'S

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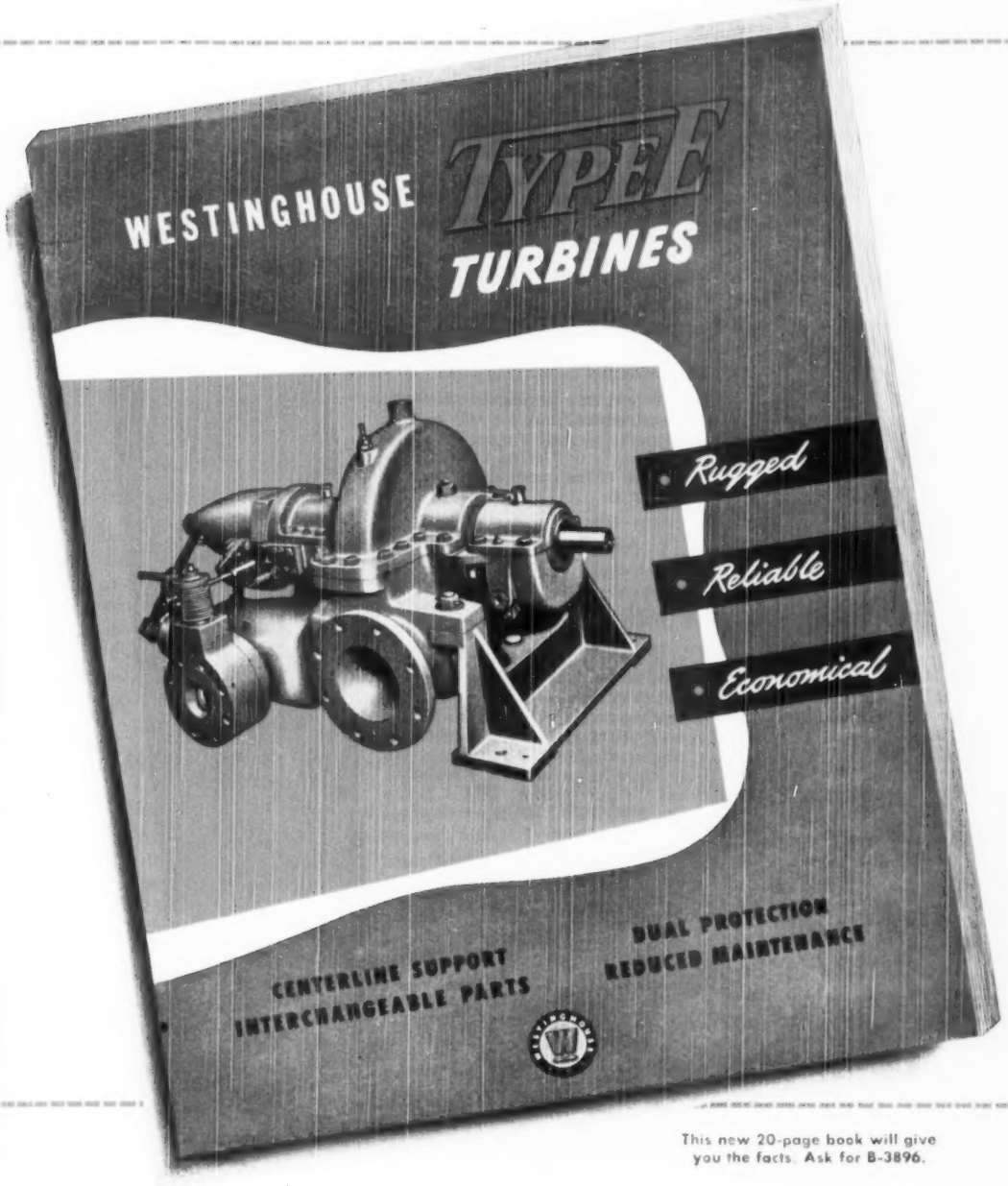
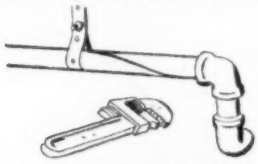


This new 20-page book will give you the facts. Ask for B-3896.

Take THIS WAY OUT of your STEAM RETURN LINE TROUBLES

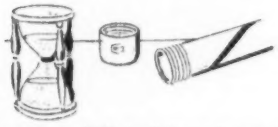
No matter what the situation is in other piping services, it's a safe bet that practically every plant has a serious *corrosion threat* in its steam return lines . . . and a recurring *maintenance problem* unless proper safeguards are utilized.

You can take different steps to modify the corrosive conditions—such as utilizing a deaerating heater—and to eliminate danger



points—by reaming the ends of all pipes, making-up joints properly, pitching lines so there are no low spots, and following good installation practice in other respects. But after you've done all this, the pipe must still carry a highly corrosive fluid, and the only final safeguard is to use a corrosion-resisting material. Engineers all over the country are finding the answer in Byers Wrought Iron pipe.

As an indication of how successfully wrought iron pipe stands up in return line service—one study



covering 125 buildings located in 25 cities in 17 states revealed wrought iron installations still serving after periods up to 70 years. The fact that such long service was not due to mild conditions was demonstrated by reports on the use of low first-cost materials. In every area, repairs and replacements had been necessary in a fraction of the comparative service life *to date* of wrought iron.

It is only natural that wrought iron should offer unique service properties, because it is unique in composition and structure. The tiny fibers of glass-like silicate slag that are threaded through the body of high-purity iron halt and "detour" corrosive attack, and so discourage pitting. The fibers also anchor the initial protective scale, which shields the underlying metal.

If you are having trouble with your return lines, we will be glad to study the problem with you, furnishing a bottle for collecting a sample of the condensate—having

it analyzed in our laboratory—*evaluating* the findings, as they affect corrosive activity—and reporting on the experience of other engineers with wrought iron in similar situations. If you would like to know more about the material, ask for our booklet, THE A B C's OF WROUGHT IRON which gives the whole story.

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POWER

PHILIP W SWAIN, EDITOR • MARCH 1950 • ESTABLISHED IN 1882

Invention

THERE WAS A TIME when inventors got most of the credit for material progress. Today, we spotlight research as the fountain of progress, which is all right if we don't overlook the inventor. Priceless new knowledge flows from research, but that can't serve mankind until some inventor converts it into a product or a process.

In brief, research means discovery, and invention means creation. We must have both, but let's pay more attention to the inventor—the creator.

In a recent Clayton lecture before the (British) Institution of Mechanical Engineers, E G Bailey, distinguished American inventor and ASME past president, stated the case for invention in clear terms. The full story is far too long for our available space, but here, in highly condensed form and in our own words, are a few key thoughts from the Bailey address, to guide and inspire progressive power engineers everywhere.

THE CASE FOR INVENTION

Invention: The conception of a new means to fill a need.

Research: Organized search for new knowledge. Research is not invention, but may lead to invention.

Chain of Inventions: One invention leads to another. Each is a link in a chain that extends back to antiquity and ahead into the unknown future.

Why Do Men Invent? Inventors seek products, processes and services that (1) are new (2) save labor (3) use less material or equipment (4) use less-critical materials or equipment (5) cost less or (6) take less time.

Also, men invent for the gratification of accomplishment and to benefit mankind. More often than not, profit is secondary.

Primary Inventions: Unlike anything in nature or in previous knowledge. Hence, inventors of genius are required. Examples: wheel and axle, steam engine.

Secondary Inventions: Have some background, but require great inventive ability. Examples: telephone, arc lamp, electric motor, steam turbine, phonograph, airplane, television.

Easiest Inventions: Improvements and new uses of old ideas. Examples: spear, bow and arrow, weaving, fire by friction.

PATTERN FOR INVENTION

Observe nature to understand the working of natural laws.

Stock memory with useful observations.

Analyze, coordinate and associate this knowledge.

ACTUAL STEPS OF INVENTION

Study previous work and present practice.

Work in field with own hands (very important).

Give free reign to imagination.

Keep thinking of problem day and night.

Keep revising sketches and mental pictures.

Watch for flash of inspiration when you awake.

Experiment to check and prove ideas.

First design is rarely best, so try changing sizes, shapes and details in steps.

Search diligently for the link that is often missing and hard to grasp.

Keep network of thought open for weeks or months.

REDUCTION TO PRACTICE

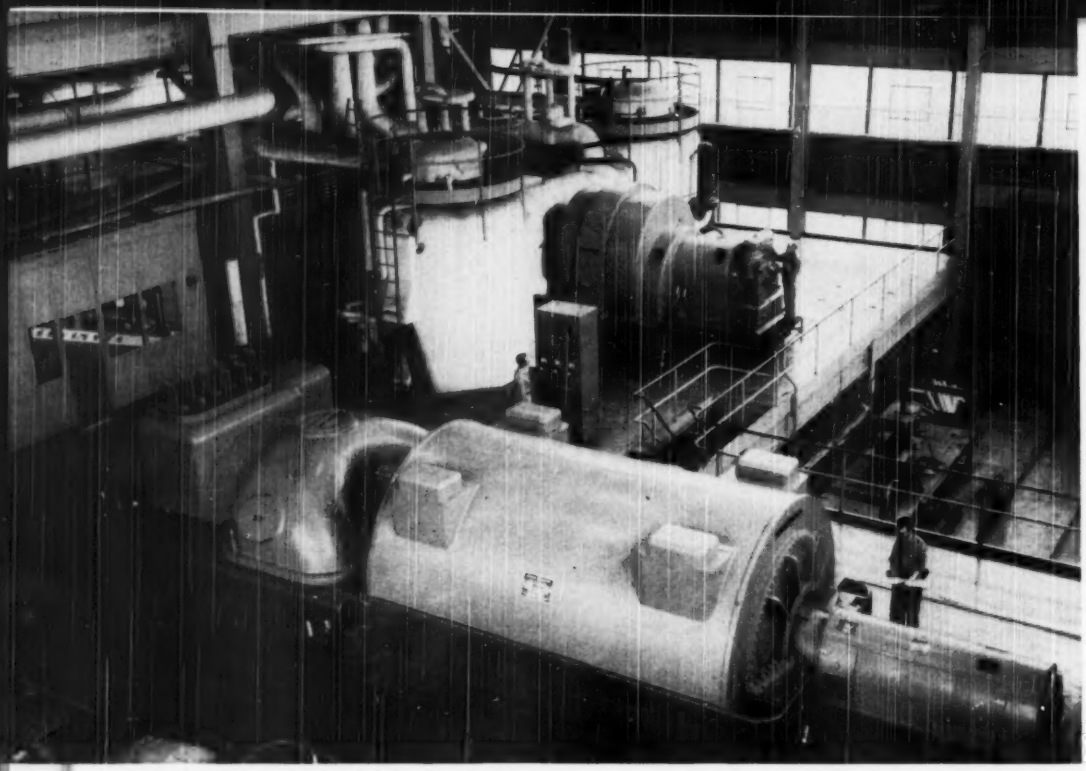
Never market an invention without thorough testing.

Make sure it meets all field conditions.

Invite criticisms and suggestions.

Don't let pride of authorship prevent the acceptance of every possible improvement in original idea.

But, after product is in general use, avoid the great extravagance of too frequent changes even though they are improvements.



SCHILLER STATION, Public Service Co of New Hampshire, has two 7500-kw mercury units (one in background) feeding conventional 25,000-kw condensing-steam turbine in foreground. Each mercury turbine has two condenser-boilers producing steam

Utility and Industrial Plants Harness

Versatility of mercury-steam cycle leads to installations in central station for electric generation and in industrial plant for electric and steam supply. Standardization of mercury-unit power plant helps minimize first cost, simplifies application problems. Low circulating water requirements per kw of total capacity and inherently high thermal efficiency make installations economically superior for given conditions. Here are details of equipment and operating method

► INCREASING PRESSURE from rising fuel and labor costs forces power-plant designers to find ways of producing cheaper kwhr. One line of attack that has been persistently pushed in this battle is development of the binary-vapor cycle. The mercury-steam cycle has been the most promising in demonstrating superior thermodynamic characteristics (see POWER, Jan 1947, pp 72-76). Three practical plants have been in operation at South Meadow, Kearny and Schenectady for quite a few years. Now, 1950 marks the initial operation of three mercury-unit power plants of standard design. This latter feature makes marked contribution to reducing investment costs. This, together with high thermal efficiency, should make the mercury-steam plant increasingly acceptable on an over-all economy basis.

The mercury-unit power plant can be adapted to a wide range of steam

SUPERVISION OF STATION mechanical equipment at Schiller centers in boiler and turbine control room. Board at right has annunciator system indicating abnormal operating conditions as they occur. Combustion controls, meters on far board

7500-Kw Standard-Design Mercury Units

conditions, simplifying its application as a topping unit for an existing or new plant. The condenser-boiler takes the high-temperature low-pressure exhaust mercury vapor and transfers its energy to the feedwater. This simultaneously condenses the mercury vapor and evaporates the feedwater. In effect, the condenser-boiler is an evaporator, making it possible to tolerate water of poorer quality than in a conventional steam cycle. Ideally, the saturated steam and exhaust mercury vapor should have equal temperatures. But to limit the condenser-boiler surface for economic reasons a temperature difference of 30 F is allowed.

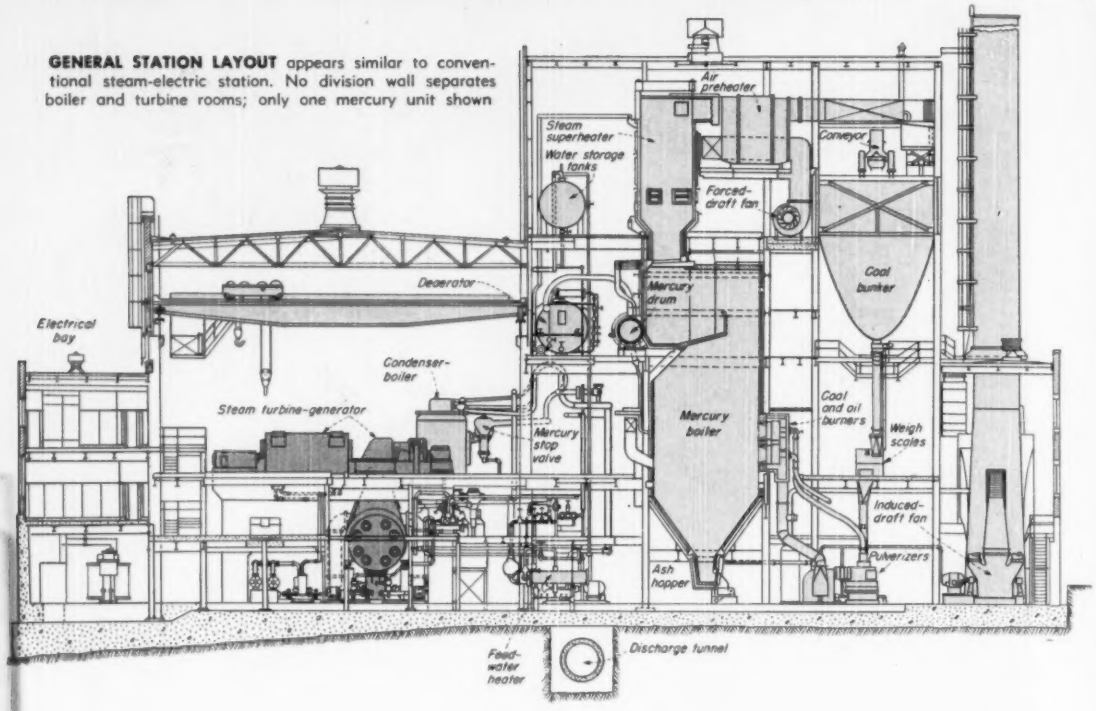
Of the three 7500-kw mercury-unit power plants, two are installed in the Schiller Station, Portsmouth, N. H., of the Public Service Co of New Hampshire, and one in the Pittsfield, Mass. plant of the General Electric Co. Following a brief description of the Schiller Station layout we give a complete description of the industrial application at Pittsfield with details of the standard mercury equipment.

Schiller Station is the first one to consist solely of a mercury-steam unit. Two standard-design 7500-kw mercury units working in parallel supply steam to a conventional 25,000-kw steam turbine-generator, making an integrated unit with a total capacity of 40,000 kw.

Each mercury turbine has a single mercury boiler fired by either pulverized coal or oil. The conventional firing equipment includes a set of low-load fuel-oil burners for expected station minimum-load conditions. At present the boilers are burning fuel oil.

The entire station follows general arrangement of usual steam-generating stations with only minor differences accommodating the mercury requirements. The electrical control room above the turbine-room floor gives the operator a complete view of the operating area. This will be valuable in emergencies, especially if the communication system should fail. A central-control room on the main operating floor supervises operation of the station mechanical equipment. Control switches in this room start and stop practically all the auxiliaries. The three main turbine sets, however, are started by hand control at the units. With the units on the line their loading is supervised either automatically or manually from the central-control room.

Station may be operated to control the system frequency by manipulating mercury- and steam-turbine speed governors. At present the station runs as a baseload unit. Its 9200-Btu-per-kwhr heat rate dictates such utilization. The station gross capacity will be the same when burning either coal or oil. The net sendout will be slightly less with coal firing because of higher auxiliary



GENERAL STATION LAYOUT appears similar to conventional steam-electric station. No division wall separates boiler and turbine rooms; only one mercury unit shown

power consumption. Lower auxiliary power needs and higher boiler efficiency result in better station heat rate when burning oil. Expected heat rate when burning oil equals 9200 Btu per kwhr, when burning coal it is 9420 Btu.

Mercury and steam pressures and temperatures were selected conservatively throughout, consistent with basic requirements of high over-all plant efficiency, and reasonable plant cost and maintenance. The designers are gratified by plant performance and operation to date.

With no previous mercury-station experience the operators have assumed complete responsibility in a very short time, with only minor supervisory assistance from the designers. This resulted from capability of personnel and operating simplicity of equipment.

Mercury Unit Tops Pittsfield Plant

By VORRAS A ELLIOTT
Construction Engineering Div
General Electric Co

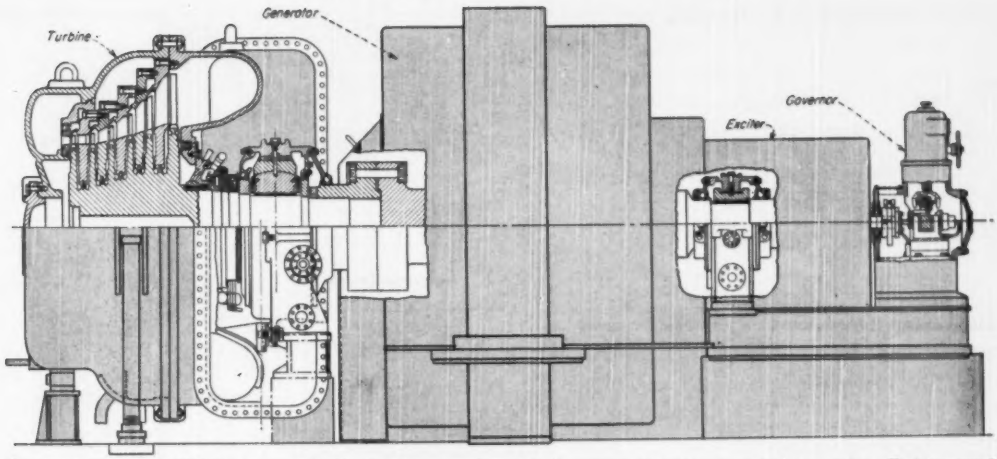
► In 1945, a comprehensive study was made of future needs for steam and power in the Pittsfield Works of the General Electric Co. Based on the anticipated business volume it showed that by 1950 electrical demand would be over 30,000 kw, and steam would be 300,000 lb per hr. Power-station capacity was 15,000 kw, with 270,000 lb per hr in 640-psig boilers and 80,000 lb per hr in four obsolete 190-psig Stirling boilers.

To meet the increased demands either additional capacity would have to be installed, or more power purchased from public utility service. Increased steam-generating capacity was also needed as the 190-psig boilers, which had run for 40 years needed replacement.

One solution would add a new steam boiler to firm up steam supply and buy all additional power from the public utility. But a considerable block of by-product electrical power could be realized from production of the additional steam needed. It was decided to install a turbine-generator to develop this power, and to buy the remainder.

Alternatives. Two methods were considered: (1) add 640-psig boilers and a third 7500-kw double-automatic-extraction condensing turbine-generator (2) install a 7500-kw mercury-unit power plant to top the existing 640-psig steam system. The mercury unit was selected because savings from increased efficiency more than justified the additional investment. Another determining factor was that the condenser cooling-water load on Silver Lake was too high. No other practical source of circulating water was available.

The question might be asked, "Why wasn't a steam topping unit given consideration?". In an industrial power plant the desired ratio of electrical generation and steam production must



1 Six-stage rotor of 7500-kw mercury turbine overhangs main bearing, turns at 1200 rpm. Air cools salient-pole generator by means of bottom-mounted air cooler. Turbine-speed governor mounts on outboard end of direct-connected exciter

be held. A 1500-psig 950-F steam turbine exhausting at 640 psig produces about 16 kwhr for each 1000 lb of 640-psig steam flow. The mercury topping unit, on the other hand, produces 66.5 kwhr per 1000 lb. This is the balance needed for the Pittsfield load. Mercury topping units give a higher ratio of electric energy to steam produced than steam topping units. In this case about four times more electrical energy for the same steam flow.

Heat Rate. Fig. 4 gives a one-line diagram of the mercury unit as installed in Pittsfield. Operating the turbine at 7500 kw produces 113,000 lb per hr of 640-psig 825-F steam. Passing this steam flow through the existing extraction turbines, operating condensing with two stages of feed heating, produces an additional 9670 kw. The over-all performance follows:

Mercury-turbine output, kw	7,500
Steam-turbines output, kw	9,640
Gross output, kw	17,140
Auxiliary power, kw	800
Net output, kw	16,340
Mercury-boiler heat input, million Btu per hr	177
Net heat rate, Btu per kwhr	10,800

Building. Fig. 2 shows a plan of the mercury-unit plant at the operating-floor level. Enough floor space was available in the existing boiler room for the mercury boiler and auxiliaries after removing the four low-pressure Stirling boilers. All the old boiler building in this area was removed to pour a new foundation mat. Existing turbine room was extended to cover the area occupied by the mercury turbine and accessories. This extension has enough space for a new boiler feedwater pumping and heating station, triple-effect evaporator for makeup, 5000-cfm and 2400-cfm air compressors.

Fig. 3 shows a sectional elevation of the boiler and turbine rooms. Piling supports the concrete mat for the boiler- and turbine-room building.

Fuel and Ash System. The boiler burns either coal or oil. Belts convey coal from an existing storage yard to the bunker. From here coal passes through weigh scales to two ball-type pulverizers. Pulverized coal goes directly to four burners. When burning oil, the burners receive it from the station's oil pumping and heating system. A 700,000-gal reinforced-concrete tank stores the oil.

A pneumatic removal system takes the ash from the main boiler hopper, mechanical flyash precipitator and stack. Ashes accumulate in a tile silo until removed by a truck through a dustless unloader. The precipitator between superheater and air heater reduces erosion by flyash of the air heater and induced-draft-fan blades.

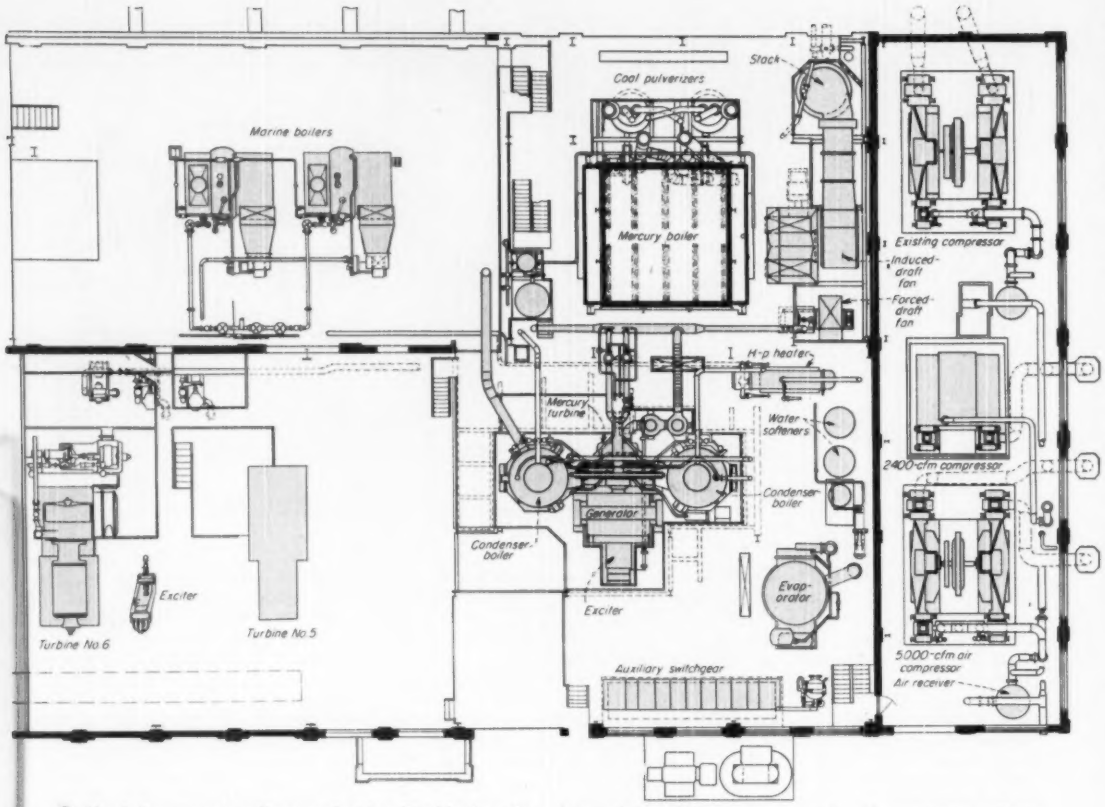
Air-type soot blowers with automatic sequential blowing remove soot from boiler and superheater surfaces. A single-stage air compressor takes air from the factory 80-psig system, boosts it to 500 psig, and stores it in a 580-cu-ft receiver. Air fed to the blowers comes from a 100-cu-ft 250-psig receiver supplied through a reducing valve from the 500-psig receiver. Control for sequential blowing mounts on the main boiler control panel. Conventional safety valves protect receivers and air compressor. An additional protection for the 500-psig receiver is a 20-in. rupture diaphragm designed to let go at 1½ times working pressure.

Mercury Equipment. Care was taken to design units that could be shop-assembled, thereby reducing field-erection costs. The boiler was shipped in large sections to minimize the number of field welds. The mercury turbine was shipped completely assembled, needing only mounting on the foundation and connection of generator and auxiliaries. The condenser boilers were shipped completely shop-assembled on rail cars.

Mercury Boiler. The boiler, Fig. 6, consists of a dry-ash hopper-bottom furnace, vertical slag screen and two convection passes with the steam superheater mounted directly above the second convection pass. Mercury tubes spaced on 1¾-in. centers line the furnace. Furnace-tube lower headers are fed with mercury by two main supply pipes branching to the individual headers. Each main supply pipe is fed by three down pipes connected to the bottom of the drum. The front-wall tubes (burner wall) feed the slag screen and lower convection tubes. Rear-wall tubes feed both upper and lower convection tubes. Side-wall tubes discharge into headers at top of the furnace. Each upper side-wall header connects to the drum with an external pipe.

Each individual tube discharges so as to eliminate possibility of reversed circulation. Front- and rear-wall tubes connect directly to the drum. Side-wall tubes enter the upper headers in a manner to prevent downward or reversed circulation.

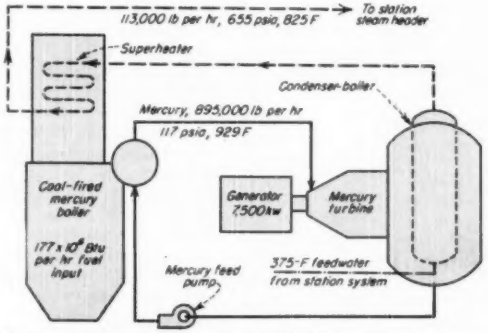
Cold mercury level, 1 foot below the inside bottom of the drum, means that the mercury fills only 9.6% of the pressure-parts volume initially. On an-



2 Here's how mercury-unit power plant has fitted in the existing steam plant. It replaces four old steam boilers and feeds into existing 640-psig steam main. Mercury-vapor exhaust generates 640-psig saturated steam in the two condenser-boilers

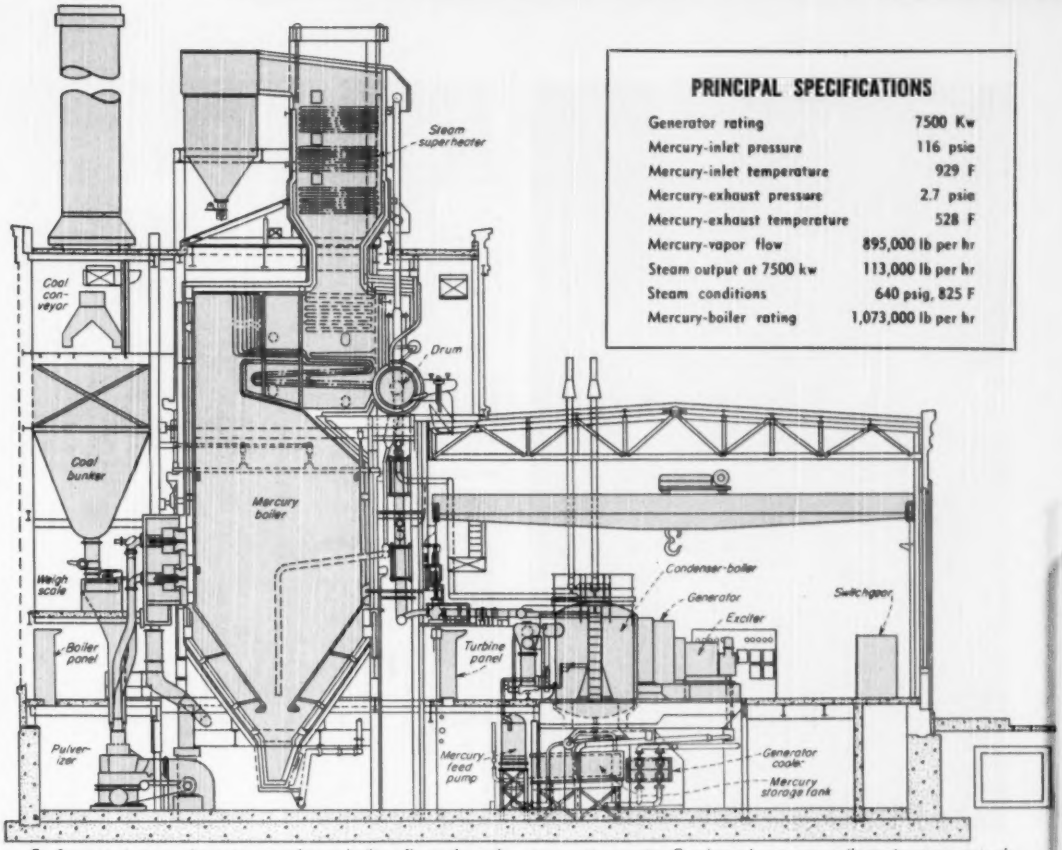
other basis, the mercury covers 35% of mercury-heating surface, initially. When firing the boiler, the mercury increases in volume and a considerable percentage of it in the furnace tubes is displaced by mercury vapor. This bloating fills the other 90.4% of the volume with a mixture of liquid and vapor.

The convection surface has been called "fog surface" as it contains a mixture of vapor and liquid. Early boilers needed 100% of the heating surface filled with mercury, calling for a much higher mercury investment. Fog surface has been a major factor in making the mercury unit commercially feasible. The drum is designed for 150-psig and 985-F conditions. Maximum pressure at the lower headers, because of the static head of mercury, will be about 350 psig. The mercury-boiler furnace tubes and those of the lower convection surface are made of B&W alloy, Croloy 5S1, while the upper convection surface tubes are Croloy 3M. External boiler piping and drums are fabricated of ASME SA-280 alloy steel.



4 Heat-balance diagram at rated load shows mercury to steam-flow ratio of 7.92 to 1. Note the high mercury-inlet temp

In a high-temperature boiler one of the major problems is hangers that support the loads and still provide for thermal-tube expansion. Front-wall tubes of this boiler increase vertically by over 4 in. from cold to operating temperature. Furnace-wall tubes suspend at the top from rod hangers and are free to expand downwards. Tubes are held in proper position with respect to furnace walls by a linkage system that holds the tubes laterally, but permits



PRINCIPAL SPECIFICATIONS

Generator rating	7500 Kw
Mercury-inlet pressure	116 psia
Mercury-inlet temperature	929 F
Mercury-exhaust pressure	2.7 psia
Mercury-exhaust temperature	528 F
Mercury-vapor flow	895,000 lb per hr
Steam output at 7500 kw	113,000 lb per hr
Steam conditions	640 psig, 825 F
Mercury-boiler rating	1,073,000 lb per hr

3 Saturated steam from two condenser-boilers flows through superheater at mercury-boiler flue-gas outlet before entering station main. Condensed mercury collects in storage tank before being picked up by mercury feed pump on way to boiler

perfectly free vertical motion as needed.

The convection surface is supported within the furnace from the main boiler steel on about two-thirds of the rear-wall furnace tubes, which turn upward from the furnace arch at the support locations. The end of the upper last pass of the convection surface near the rear wall is supported by alloy hangers from the main boiler steel. The two main-supply tubes to the lower headers are supported on a linkage system, which properly positions them in a vertical direction as a function of the mercury temperature flowing through the tubes. The linkage system assures proper distribution of vertical deflection between large- and small-diameter supply tubes.

Fig. 6 shows two bypass dampers in the upper convection surface for steam superheat control. With the superheater following the boiler outlet, the superheat temperature drops considerably as load decreases. During summer weekends in Pittsfield, the mercury unit may have to be operated at minimum loads. At such times the superheater-outlet temperature should be kept as high as possible. Superheater-outlet steam temperature at boiler rating equals 825 F when convection-surface bypass dampers are closed. As unit load drops, manipulating the dampers maintains outlet temperature at 825 F down to a load of 5700 kw on the mercury turbine. As load continues dropping with dampers wide open the temperature falls to 790 F at 3400-kw.

The boiler nameplate rating specifies 1,073,000 lb per hr of mercury vapor at design pressure and temperature of 150 psig and 985 F. Performance was calculated for a fuel having the following proximate analysis:

Moisture	2.88%
Volatile matter	17.22
Fixed carbon	71.3
Ash	8.6
Total	100.0%
Ash temperatures:	
Initial deformation	2000 F
Softening	2250 F
Grindability	80%

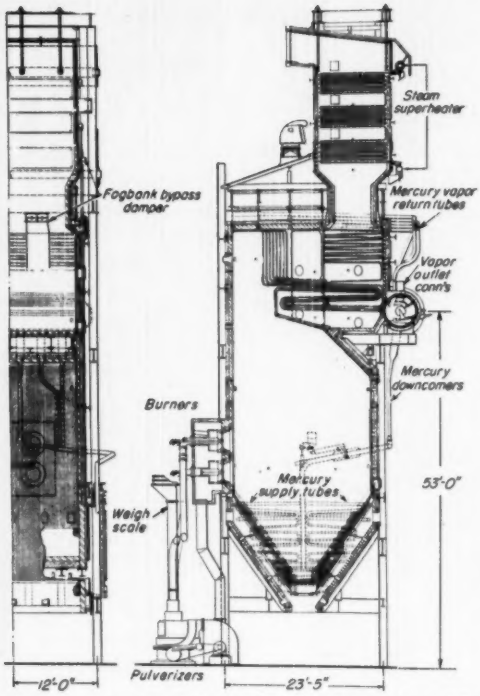
This fuel burns to develop an overall boiler efficiency of 84.5% with a stack temperature of 400 F and preheated air to burners at 507 F.

To insure that low-grade coals could be burned and still have a dry-ash furnace, the liberation rate was kept extremely low. At the boiler nameplate rating the furnace liberation is 15,700 Btu per hr per cu ft. At a mercury-turbine load of 7500 kw and vapor flow of 895,000 lb per hr, heat release is only 13,050 Btu per hr per cu ft.

The mercury-boiler furnace-tube sections were erected in 18 shop-assembled units. Tubes were all welded to their respective headers in the shop. Only connections to the convection surfaces and drum had to be field welded. Fig. 5 shows one of the side-wall sections being moved into position.

Mercury Turbine-Generator. The mercury turbine produces 7500 kw with mercury conditions of 116 psia and 929 F, and an exhaust pressure and temperature of 2.7 psia and 528 F. Increasing mercury pressure develops

5 Shop-assembled units of mercury boiler were welded together in the field. Prefabrication helps reduce installation cost



6 When cold, mercury fills only 9.6% of boiler volume. When operating, vapor-liquid mixture fills the boiler completely

higher outputs. Maximum output for the Pittsfield exhaust pressure, at boiler rating of 1,073,000-lb-per-hr vapor flow, equals 9250 kw.

Fig. 1 shows a cross section of the mercury turbine. The 6-stage turbine rotor overhangs the main bearing in a 2-bearing arrangement. The 1200-rpm turbine connects directly to the salient-pole generator with a direct-connected exciter. Governor and overspeed trip mount at the exciter end of the shaft because the shaft does not extend through the shell at the turbine mercury inlet. The main bearing pedestal and two cylindrical columns, extending from the foundation to the feet, support the turbine shell. The feet mount on the casing at the shaft center line. The main bearing acts as the anchor point of the machine. The cylindrical columns supporting the shell have pivoted ends that permit them to tilt as the shell expands thermally. Guides hold the inlet end of the shell in line and permit expansion, both parallel to the shaft and downward. They prevent movement in a lateral direction.

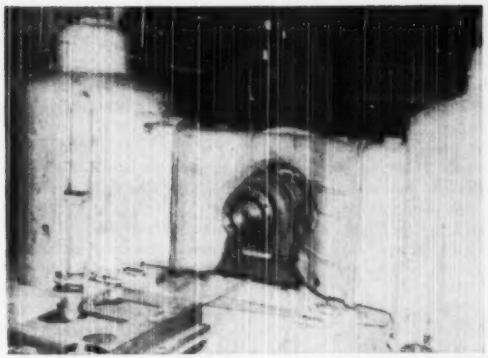
Turbine rotor, nozzles and diaphragms may be serviced by removing the high-pressure shell. Turbine has double side-exhaust openings connecting directly to two condenser-boilers. Vacuum system will have an air leakage of less than ½ cu ft of free air per hr. Fig. 1 shows the flanged connection covered with welded metal seals preventing possibility of air leakage into the low-pressure system. Seals over the high-pressure flange prevent mercury-vapor leakage into the room. With the system tight the main potential source of air leakage is through the shaft seal. The running seal has a rotating mercury-filled cup as an integral part of the shaft. A stationary knife edge extends into the mercury to form the seal. Mercury circulates through the cup and heat exchanger to remove heat generated by the friction losses. Air leakage through the running seal is essentially zero.

When starting the mercury boiler the system pressure is dropped below 0.5 in. Hg abs. This requires sealing the turbine shaft while stationary. Two sets of labyrinths in the shaft seal assembly have mercury pumped through them by the mercury-boiler feed pumps. Flow regulation maintains the pressure between the sets above atmospheric. Mercury flows through the seals and returns to the feed pumps. A heat exchanger in the recirculating system removes the heat produced by the pumping losses and pipe friction.

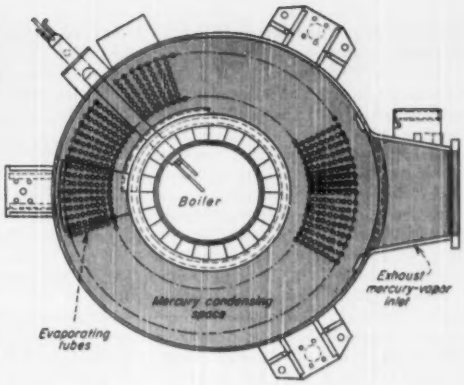
With the stationary shaft seal the unit can be taken out of service without air entering the mercury system until after the unit cools. Passing neutral gas through a carbon seal assembly mounted on the atmospheric side of the shaft seal prevents oxidation of the mercury.

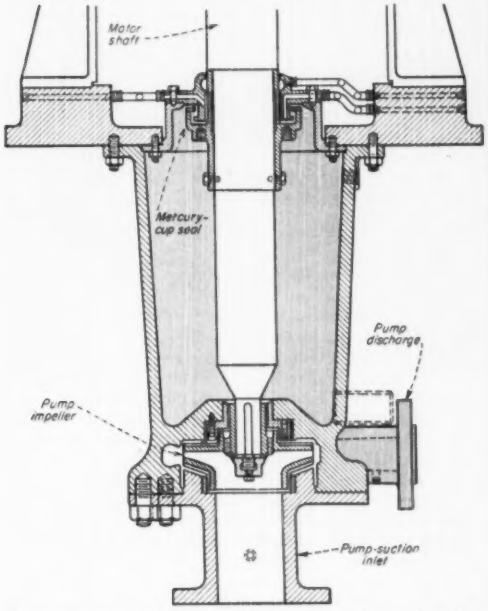
Generator is rated at 7500 kw, 0.8 pf, 9375 kva, 13,800 v, 3 phase, 60 cycles, 1200 rpm. Speed does not need a solid-type rotor, so a salient-pole type was selected because of lower cost. A conventional direct-connected exciter serves the generator. Generator is cooled by bottom-mounted type air coolers.

An oil tank on the basement floor at

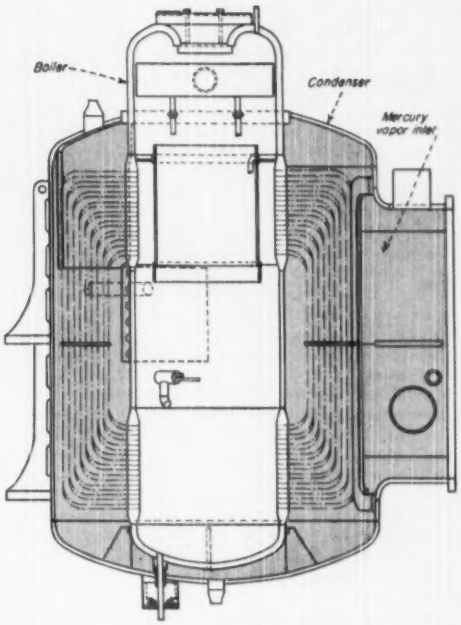


7 Two condenser-boilers connect to side-outlets of mercury-turbine exhaust. Generator couples to turbine shaft, center





8 Single-stage mercury-boiler feed pumps take suction from storage tank, have positive head. Mercury cup seals shaft



9 Steam drum and tubes of condenser-boiler stand within the mercury-vacuum shell. Note distribution lane around tubes

the turbine's inlet end supplies the turbine-oil needs. A motor-driven pump transports both control and bearing oil. A steam-driven pump operates if motor or power supply fail. An emergency d-c motor-operated bearing-oil pump brings the turbine to rest if both motor- and steam-driven oil pumps become inoperative.

Mercury Condenser-Boilers. These elements were designed so they could be shop-assembled and shipped as units. The proportions had to conform to the railway clearances during shipment. Fig. 7 shows the condenser boilers just after being placed on the foundation. Fig. 9 shows arrangement of steam drum, tubes and vacuum shell. The vacuum or mercury-vapor shell forms the structural support for the drum and tube bundle. The condenser-boiler inlet flanges connect direct to the turbine-exhaust flanges. They must be supported so as not to impose excessive strains on the turbine casing when thermal expansion occurs. Shell supports are on same vertical elevation as the turbine shaft. Reactions transmit to the foundations by pivoted end columns similar to the ones for the turbine high-pressure shell, which permit free lateral movement. Guides on the outboard condenser supports ensure the condensers moving perpendicular to the turbine shaft to reduce strains on the turbine casing.

Each condenser-boiler produces 61,000-lb-per-hr saturated steam at 665 psig, with a terminal difference of 28 F across the tubes. Center line of drum and tube bundle offsets from center line of vapor-space shell to provide

space between outer tubes and shell for distribution of mercury vapor.

A section of the water tubes acts as a cooler for the air and noncondensable gases removed from the condensers on the side opposite the vapor inlet. Conventional boiler connections, such as blow-down, boiler-feed, level and sampling lines, come out through the mercury-vapor space and outer shell through bellows. These act as seals and provide for differential expansion between drum and outer shell.

Mercury Feed Pumps. Two motor-driven vertical mercury-boiler feed pumps can each supply the boiler at full rating. These single-stage pumps develop a flow of 1,350,000 lb per hr against 110-ft head at a pumping temperature of 530 F. This performance is based on 0-psig pressure at the impeller center line. Pump impeller mounts on the motor shaft extending about 30 in. below the bottom of the motor base, Fig. 8. The long shaft extension was needed because the pump takes its suction from a storage tank in which the mercury level may be several inches above center line pump impeller.

Mercury leakage from the upper clearance between impeller and casing returns to the storage tank through a drain provided in the low point of the pump-support casing. A rotating mercury-filled cup seal is provided on the shaft a few inches below the motor attachment. An inert-gas atmosphere is maintained in the storage tank and the pump casing below the cup seal.

Piping and Valves. Mercury-vapor pipes connecting boiler and turbine are fabricated of ½% chrome, ½% moly alloy steel tubing conforming to ASTM Specification A-204. The 825-F superheated steam line was fabricated from carbon-moly seamless-steel tubing meeting requirements of ASTM Specification A-206. Low-carbon steel piping ASTM Specification A-106 was used for all other station piping.

Two mercury-boiler safety valves connect directly to the main mercury-vapor header and discharge into the condenser boilers. Relief-type safety valves (instead of pop-type normally used on steam boilers) minimize shock loads on the condenser boilers when the safety valves open. When station steam demand exceeds that corresponding to electric load on mercury turbine-generator, safety valves operated with hand-wheels bypass mercury vapor to the condenser-boiler to produce more steam.

Valves with bellows-sealed stems on all vacuum lines and on a majority of the mercury lines eliminate stem-packing leakage problems. In a few cases, where bellows-sealed valves could not be obtained for the mercury feed lines in the sizes and pressures needed, standard steel valves with all ferrous parts are used. Turbine stop valve is only valve between boiler and turbine.

Meters and Control. The mercury boiler has automatic combustion control. On a steam boiler the control usually holds constant pressure. When the mercury unit runs base loaded in parallel with other turbines and steam boilers, it operates on wide-open throttle. Increasing or decreasing the fuel-burning rate controls the load changes and varies the boiler pressure and vapor flow.

When operating with the station steam boilers, the mercury boiler will be controlled by setting the fuel-burning rate with a hand-controlled valve. A steam flow-air flow meter approximates air-fuel ratio, and final corrections are made by an oxygen recorder. Station steam header pressure will be maintained by existing boilers taking fluctuations in steam load. When none of the steam boilers run, mercury boiler load will be regulated from the steam-boiler master control to hold station steam-header pressure. Control panels for the boiler and turbine are in their respective rooms. The mercury flow and level meters, of the bellows type, transmit their deflections electrically to the control boards. Transmitter elements close to point of measurement minimize length of runs of mercury-filled meter piping.

Of the two flowmeters used on the mercury system, one measures mercury fed to the boiler and the other internal mercury-boiler circulation. Two level instruments record mercury level in the boiler, while a third records and controls mercury-feed pump suction level.

An instrument on the boiler board records the temperature of each boiler furnace tube every half hour. Thermocouples, attached to each of the 534 tubes, connect to the recorder through a 600-point transfer switch. The thermocouples, all installed at one level on the boiler tubes, are easily serviced by removing small panels in the boiler casing. Recorder pen draws a series of horizontal lines on a moving strip chart as the various thermocouples connect to the instrument through the transfer switch. Low-temperature end of each line gives the drum-saturation temperature, and the high end the tube temperature. Length of the line indicates tube temperature rise above drum saturation. The rise is more important than actual tube temperature because drum pressure and temperature fluctuate with load.

Flue-gas samples from the superheater exit pass through two mercury detectors, which sound an alarm when mercury vapor is present. One detector of the chemical type consists of a selenium-sulphide coated paper over which the flue-gas sample passes. Black compounds of mercury sulphide and mercury selenide form in the presence of mercury vapor with a concentration as low as one ppm.

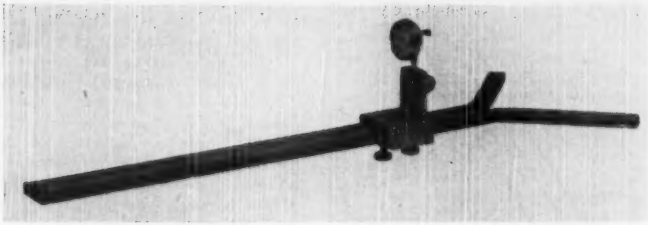
The other detector of the optical type passes the gas sample between an ultraviolet light source and a photoelectric tube. Through suitable circuits the tube records mercury-vapor concentrations on a boiler-board meter. This instrument detects one part per hundred million of mercury vapor in the flue gas. A cubic centimeter of mercury, thrown into the furnace daily, tests the mercury detectors.

Mercury Auxiliaries. Two motor-driven vacum pumps remove noncondensable gases from the condenser boilers. The gases pass through a primary finned-tube air-cooled heat exchanger and over secondary watercooled surface to remove any mercury vapor present before entering the vacuum-pump inlets. Both pumps in parallel pump down the system during startup, but only one is needed under load.

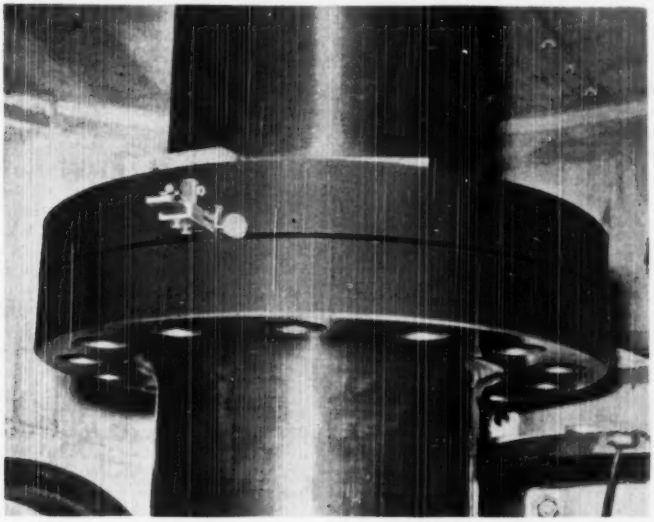
Nitrogen from the factory header supplies the storage tank and boiler feed pump. Nitrogen also fills the system after shutdown. Gas for blanketing other mercury surfaces is obtained by burning propane in an atmospheric converter. A number of small heat exchangers have mercury on one side and cooling water on the other side of heat-exchange surfaces. In normal steam plants copper bearing materials are often used with cooling water. These materials are not satisfactory where mercury is present on one side since it will amalgamate with nonferrous alloys. Stainless steel, satisfactory for both mercury and water, is expensive. Low-carbon steel, satisfactory for mercury, has short life on the water side with untreated cooling waters. Low-carbon steel was used for heat-exchanger surface, but a closed recirculating treated-water system reduces corrosion on the water side. The station circulating-water system removes the heat by a conventional water-to-water exchanger.

Mercury Treatment. Chemical treatment of boiler mercury makes it produce a "wetted surface" to give high heat-transfer rates and prevent dissolution of the tubes by the hot mercury. Minute quantities of magnesium and titanium have produced the desired results for over ten years.

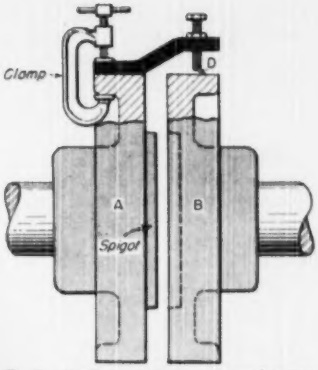
Conclusion. The Pittsfield mercury unit is an excellent example of application to an industrial plant. Features making it attractive are its ability to produce large kw output for given steam demand, no need for additional circulating water, tremendous improvement in over-all plant efficiency.



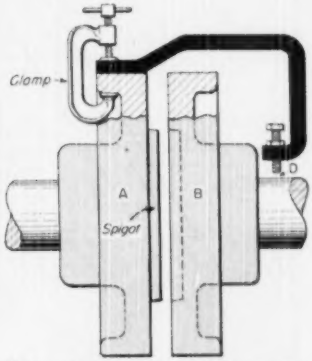
1 Coupling checker, developed originally for generators driven by vertical-shaft waterwheel, works as well when applied to the couplings of horizontal machines



When using the coupling checker, shown in Fig. 1, its V'd end is held firmly against the spigot when the flat of the checker is held onto the coupling face



2 To check coupling, measure distance D at four points around its rim



4 How to apply the test indicator when one half of the coupling is defective

Aligning Couplings to Avoid Pitfalls

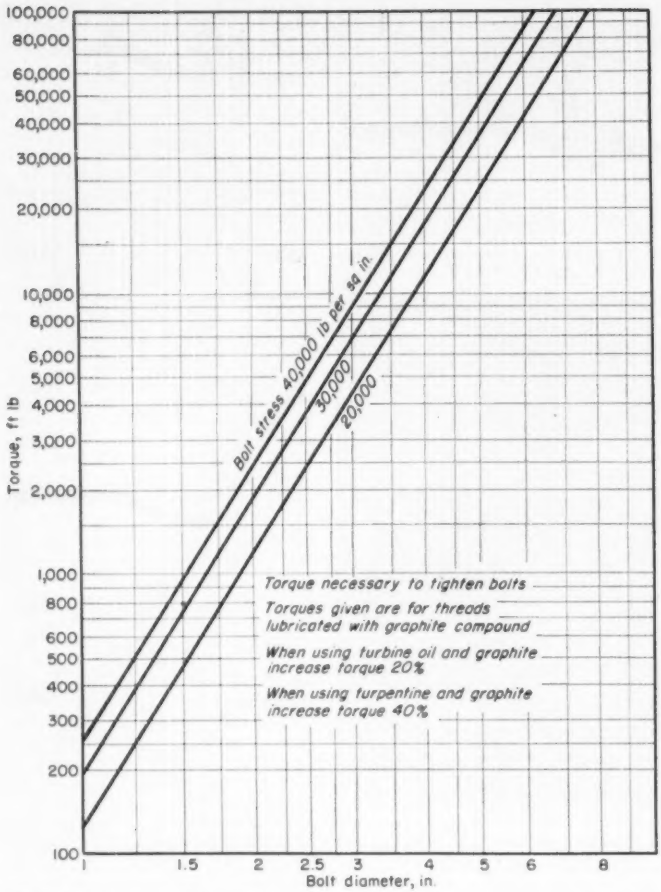
Making up a large solid coupling calls for a lot of engineering know-how if you are to avoid mistakes that may lead to serious difficulties. Here's how an erecting engineer of long experience, the late N L Rea, sidestepped broken coupling bolts, worn spigots and damaged shafts

► CORRECT COUPLING ALIGNMENT cannot be overemphasized. Particularly is this true of solid couplings or those forged on a large shaft. The machine's operation depends on how carefully this job is done. So for a successful installation, the erector should be familiar with all the tricks and pitfalls of the trade.

Before bringing two half couplings together go over them carefully, removing any burrs or bumps with a fine file or stone. Make sure metal around the bolt holes has not bulged from pressure of drills and reamers, so as to prevent the flanges from coming together solidly. Check the spigot and recess in the faces of the coupling for size and concentricity with the outside flanges.

Horizontal Apparatus. Set the first unit so the half-coupling face is vertical or plumb. To do this hang a heavy weight or plumb bob in a pail of oil. Have a steel wire a convenient distance from the coupling face within the range of your inside micrometer or a measuring pin and feelers. Insulate the wire from the ground, and connect dry cells and a bell or head phones in series between wire and shaft.

The measuring can be done with an inside micrometer adjusted until the phone clicks. Use this method, which gives more accurate readings than either touch or feel, where the light is too poor to trust to sight. Adjust the shims under the bearings or under the base



5 Torque in foot-pounds necessary to apply to nuts on bolts to put a given stress in the latter when nut and bolt threads are lubricated with a graphite compound

until the coupling-face top and bottom are the same distance from wire or plumb line. Then, and not until then, proceed with the alignment.

First step is to make certain both coupling halves are concentric with the shaft's center line, and the faces are square with the center line. In other words, faces and outside flanges must run true before aligning and bolting together.

Because couplings may be distorted when shrunk or pressed on their shafts, they should be checked in a lathe and machined or ground before they leave the factory. This precaution is sometimes overlooked so the erector should check everything as work progresses.

Separate the two halves far enough to clear the spigot fit. Block the shafts so end play cannot change when shafts are rotated for checking. Fasten a strap with adjusting screw to one half of the coupling, Fig. 2, using a C-clamp. Adjust the screw until the distance between its point and the half-coupling flange is within the range of a feeler gage.

Mark four points, 90 deg apart, on hub *B*. Measure distance *D* between the point and the flange rim, and also distance between the coupling faces, using any convenient smooth block and the feelers. Rotate *B* 90 deg, and repeat the measurements. Then repeat at 180, 270 and 0 (360) deg.

The second reading at 0 deg checks any change in the relative positions of the two coupling halves during rotation tests. If readings are the same at all four points, they show the outside of flange *B* runs true. Readings taken from the same points on *A* as on *B* show if the former's face is square and runs true with the center line of its shaft.

These suggestions assume the erector has to devise equipment for checking. If he has a dial-test indicator, he should attach it to *A* in place of the measuring strap to check circumference of the flanges. Because of space limitations the measuring block and feelers have to be used between faces of *A* and *B*, to check if they are parallel.

Either method shows if the coupling halves are true or if there is a kink in the shafts. Should either coupling run out of true, extend the measuring strap or dial test indicator around the defective half and indicate the shaft back of the hub, Fig. 4. This proves if the out-of-true is in the coupling, or if the shaft is kinked. Once the half couplings are proved true and square, alignment can be made in several ways. The desired result finds coupling faces of the two halves parallel and in alignment.

Do not set the coupling open a bit on the bottom to allow for some of the shaft deflections spinning out as the set comes up to speed. Any shaft's deflection due to the rotor weight is constant from standstill up to normal operating speed. An exception lets the rotor go through a critical speed below operating speed. Then the shaft takes a different deflection or a pair of deflections that again remain constant.

Misalignment causes excessive wear of the spigot fit, the coupling faces and bolts, and may eventually break coupling bolts or even the shafts. Many a shaft has broken without any sign of bearing distress or excessive vibration.

The old-time standard method of aligning shafts was to put a straightedge or steel scale across one coupling flange parallel to the shaft and measure with feelers between the straight edge and the top, bottom and sides of the other flange. With this method you must allow for any difference in the diameter of the two coupling halves. It is a slow, difficult job to get accurate results.

A better and simpler method is to rotate the half coupling carrying a measuring strap, Fig. 2, and measure the distance between screw point and outside of the other half coupling's flange at four points, 90 deg apart. A dial-test indicator gives direct readings quickly and accurately.

The coupling checker in Fig. 1 was developed originally for vertical units, but works as well on horizontal apparatus. The V'd end is held firmly against the spigot. The flat of the checker is against the face of the coupling, with the dial test indicator over the flange, Fig. 3. Indicator and its blocks are moved toward the flange until the dial test indicator makes part of a

revolution, then the locking screw is tightened.

Hold the checker firmly against spigot and coupling face, and make a complete revolution around the coupling. This checks the spigot against the flange for concentricity. If they check as they should, turn the checker over and measure against the other flange. The device gives direct accurate readings of alignment of the two half couplings, and amount of misalignment and direction in which the units must be moved. It also compensates for any difference in diameter of the two halves.

Flexible Couplings. Many erectors assume it is unnecessary to carefully align machines equipped with flexible couplings—in fact, they consider anything good enough. This is absolutely wrong. Flexible couplings are not intended to take care of the erector's neglect, but to compensate for slight misalignments that may occur after the unit goes in service. These variations may be caused by settling of the foundations, expansion due to temperature changes, and other unavoidable factors.

A flexible coupling permits operation, when misalignment exists, without damage to the machine, but it causes excessive wear of coupling parts. So the erector must do an accurate job in the original alignment for satisfactory coupling life.

Coupling Bolts. If a coupling's recess has a tight-fitting spigot to keep its halves in alignment, have coupling bolts loose so they can square themselves with the coupling flanges. A sixty-fourth clearance is tight enough and better than a drive fit.

Tighten all coupling bolts fingertight, and then turn each nut a face at a time until bolts show even resistance, or until you get the spring of the bolt. Torque wrenches indicate the applied torque, and are useful for bolts up to 2-in. diameter.

Large Bolts. Carefully clean each bolt and nut, and brush out the thread using kerosene or cleaning fluid. Make sure small chips, dirt or other foreign material have not lodged in the bottom of the threads. All burrs and irregularities must be removed from the threads so the nuts can be run on easily to their proper position. Otherwise, trouble may develop when tightening or removing nuts. If a thread galls it may be necessary to split or burn off a nut, and ruin both bolt and nut.

Lubricate the bolt and nut threads and the nut's bearing surface against the flange to prevent galling or seizure. Graphite is the best lubricant. Usually it is mixed with some carrier, like turpentine. But the most successful mixture is two parts graphite and one part red lead, thinned to a heavy paint consistency with boiled linseed oil. Take care to keep the brush clean and the container covered to prevent cinders, dust or other foreign material getting into the thread lubricant.

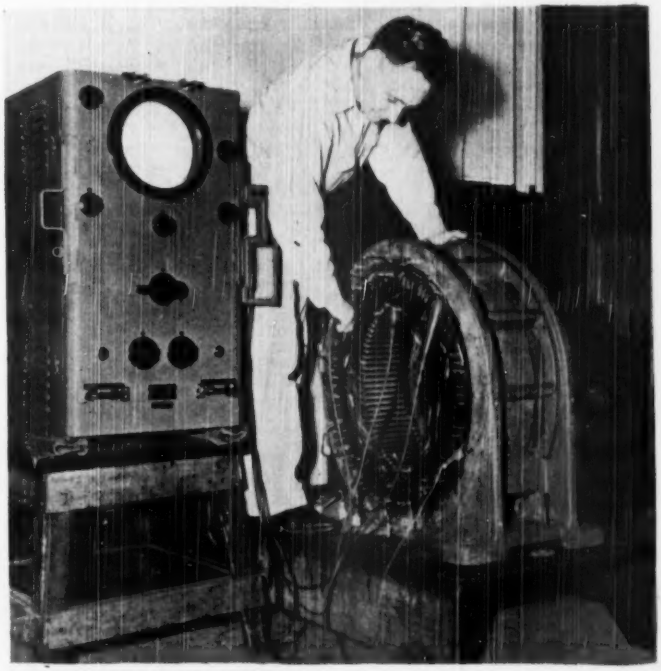
Fig. 5 gives the torque wrench values to use with this lubricant for a given stress in the bolt. For turbine oil and graphite, increase torque 20%, and for water or turpentine and graphite, increase it about 40%.

Tester Ferrets Out Motor Faults

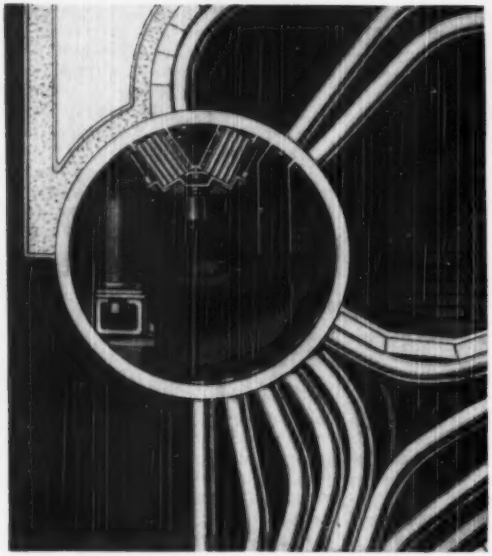
► For testing rewound and reconditioned motors at its 153rd St shops, Consolidated Edison Co, New York, installed a General Electric winding-insulation tester. These shops rewind and repair motors and other heavy electric equipment from the company's plants.

An average of 15 to 20 motors, up to 1000 hp, for 220, 440 and 2300 v, 3 phase, are tested each month. Tester locates reverse coil connections, coils with damaged insulation, unbalance in magnetic circuits in three phases, and other faults. Sometimes it is taken into the field to test equipment too large to move to the shop.

Tester is a repeating surge device, which detects faults in motors, transformers, coils. It simultaneously tests turn-to-turn, coil-to-coil and coil-to-ground insulation. Resistance, impedance, turn-balance, high-potential tests are made with one voltage application. Cathode-ray oscilloscope built into tester indicates defects.

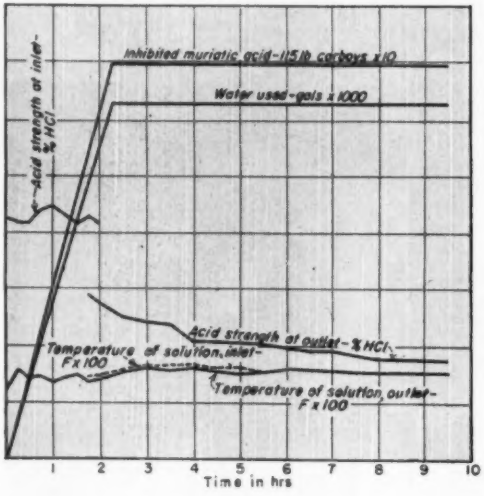


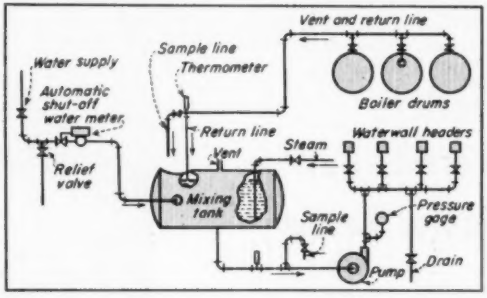
MOTOR-WINDING INSULATION TESTER locates reverse coil connections, coils with damaged insulation, unbalance in magnetic circuits in three phases and other faults



1 Scale built up heaviest under the feed pan, in cold-tube zones, and rear steam drum of a 55,000-lb-per-hr boiler

2 Inhibited acid entered the boiler through bottom waterwall headers, flowed up through boiler, out upper steam drums


Inhibited muriatic acid–115 lb. carboys x 10
Water used–gals x 1000
Acid strength at inlet–% HCl
Acid strength at outlet–% HCl
Temperature of solution, inlet–F x 100
Temperature of solution, outlet–F x 100
1 2 3 4 5 6 7 8 9 10
Time in hrs



3 Piping and principal equipment for chemical cleaning by your own plant crew of a four-drum Stirling-type boiler. One important consideration you must make is safe removal or venting of hydrogen gas released in acid cleaning process

4 Curves show how much water and chemical were used and what happened to them throughout the cleaning process

Chemical Scale Removal . . .

No longer need be considered too complicated. You can enjoy advantages of down-to-metal cleaning, low labor costs, short shutdowns by following the suggestions of C H Carter, chief power-plant engineer of Puget Sound Pulp & Timber Co

► WHEN SCALE BUILDS UP on the inside surfaces of a boiler you can look for trouble. Not only does it waste fuel but it can bring about tube failures. And that is just what happened at the Bellingham, Wash. Division of the Puget Sound Pulp & Timber Co. But something can be done about it. Here's what we did to lick our problems.

First we will describe our equipment so you'll know what we've got. Our steam power plant has four 4-drum Stirling-type watertube boilers, with

waterwalls on all four sides of the combustion chamber. When we fire hogged fuel, each boiler is rated at 55,000 lb of steam per hr. With fuel oil supplementing or used straight these boilers give 70,000 lb per hr. Each boiler has an air preheater, forced- and induced-draft fan, automatic combustion control, and all the other auxiliaries. Everything you could want for top operating efficiency.

What about water and makeup? Steam from the power plant goes into the pulp mill, alcohol plant, board mill and adjoining paper mill. Most of the processes handle the steam in such a way that we can't recover it. Only the steam from the Flakt pulp dryers, board machine and a few auxiliaries and heat exchangers returns to the steam plant as condensate. So we operate our boilers on about 30% condensate and 70% raw-water makeup. The water we use, Table I, comes originally from Lake Whatcom. But before it gets into any part of the plant—boiler house or production—we pass it through a filtering plant.

All water for the steam cycle enters by way of a direct contact deaerating feedwater heater. Here both condensate and filtered makeup water meet. Boiler water is treated chemically in the boilers themselves. With this method of water conditioning no particular scaling difficulties cropped up for a long time. At the time we put the plant into operation we wanted to hold our capital investment within a definite upper limit. Water conditioning seemed the best place to economize. So feedwater-treatment equipment was held to a minimum. Our decision seemed a sound one.

But along about 1947 something changed. Scale formed on boiler surfaces to such an extent that our tubes began to let go. We had to shut down boilers. With every unscheduled shutdown we lost out on pulp production.

Table I — Raw-Water Analysis

Hydroxide	(OH)	0 ppm
Bicarbonate	(HCO_3)	16.0 ppm
Calcium	(CA)	6.3 ppm
Magnesium	(Mg)	3.8 ppm
Silica	(SiO_2)	1.3 ppm
Chloride	(NaCl)	3.1 ppm
Suspended Solids		0 ppm
Dissolved Solids		38.0 ppm
Total Solids		38.0 ppm

Table II — Scale Analysis

Silica	(SiO_2)	11.6%
Alumina	(Al_2O_3)	2.6%
Iron oxide	(Fe_2O_3)	7.3%
Titanium oxide	(TiO_2)	0.1%
Calcium oxide	(CaO)	18.8%
Magnesium oxide	(MgO)	12.4%
Sulphate, as SO_3		1.7%
Phosphate, as P_2O_5		35.1%
Ignition loss at 1800 deg F		9.3%
Undetermined		1.1%
		100%

SCALE FORMATION

So we studied the scale to find out (1) where it formed the heaviest (2) what its nature was (3) what caused it (4) how it could be prevented or corrected.

On close examination the scale had a laminated appearance. It varied in thickness throughout all boiler surfaces. It seemed most prominent in cold-zone tubes in the last boiler pass, in the rear steam drum, and on and underneath the feed pan. The chemical laboratories looked it over and their report shows in Table II.

From their investigations we learned our scale was characterized by high calcium and magnesium phosphate sludge with a considerable silica content. Further, phosphate was far more than was needed to combine with calcium and magnesium in the raw water.

We turned over to feedwater consultants the questions of what caused the scale to form so heavily and what could be done to prevent or correct it. Our immediate job was to remove it so we could get back into production.

Our first approach was mechanical cleaning. It was something we knew. The scale or sludge build-up was heaviest in the cold-tube zones, the rear steam drum and under the feed pan. We felt we could get at them for mechanical cleaning. After the boiler had cooled down to the point where men could get in and work, we started. We turbined the tubes, scraped the drum, the feed pan and the steam baffles. All in all, it took about 30 hours to clean out just these portions of the boiler and get back on the line.

But scale kept building up throughout the rest of the boiler. It got so we had to schedule an outage of one boiler each seventh day. Or, what amounts to the same boiler coming off the line for cleaning every twenty-eighth day.

Not only were we paying through the nose for labor charges on boiler outages but we were crippling pulp production. Then and there we decided the boilers had to be cleaned thoroughly. Once we had done that we felt we would (1) eliminate most boiler outages (2) get a clean enough internal surface to determine what results we were getting from the recommended changes in water conditioning.

How should we go about the job of thoroughly cleaning all boiler surfaces? Estimates on costs and effectiveness of both acid and mechanical cleaning came in for study. Acid cleaning in our section of the country, the Pacific Northwest, had had only limited use. There were no well-developed commercial services such as those set up in the East by various larger, well-known chemical concerns.

We found out, though, that there were local laboratories and chemical manufacturers who could supply us with acids and inhibitors up to at least 96% effectiveness. With normal precautions we believed the technical force at the pulp mill could acid-clean without any detriment to the boiler surfaces.

Once we decided on chemical cleaning we had a number of problems to face. First and foremost was the complete safety and protection of all workmen and plant operators. So we got together rubber gloves, hooded masks and an adequate supply of soda solution to neutralize any burns from handling the acid. We made certain we had a good ventilation method laid out to take off all fumes and release hydrogen gas—an important safety precaution.

ACID CLEANING

After a study of the boiler and possible circulation paths we settled on a semi-circulating method for feeding the acid to the boilers, Fig. 1,3. We picked a commercial inhibited-muriatic acid of 28 degrees Baumé. Together with a pump, we felt we would get all the circulation needed within the boiler.

Our pump, a 90-gpm 40-ft-head 3600-rpm stainless-steel unit, came from our pulp-mill stores. So did all the piping, Fig. 3. We took a 650-gal tank as a mixing tank. We piped it up to our mill-water supply, added a steam connection for thorough mixing and preheating of acid solution, put in a return line for the spent acid, and tied in the pump-suction line.

The mixing or blending tank was set in a convenient spot at the rear of the boiler room. A wooden platform at about the height of the tank was built along one side. This platform makes handling carboys of acid convenient and safe.

In the piping itself—pump discharge and return lines—pressure gages, thermometers and sampling valves were installed. Equipment was set up for on-the-spot testing of acid strength going into the boilers and on the overflow line returning from the boiler.

Since the acid had not been inhibited against attack of bronze, or other metals

besides iron and steel, we had to blank off all safety, feedwater-supply and water-column valves. Some units, like blowoff valves, we removed entirely, and blanked the flanges. We put in synthetic-rubber plugs in all connections from the steam drum to the superheater. We had found these tubes free of scale.

We were now all set to go. Our waterwalls and boiler drum together held 7140 gallons of water. We had no accurate idea of the amount or weight of scale within our boilers. So we guessed at it.

How could we make an intelligent guess? We figured up the condensate we would collect in our mixing tank when we heated our acid solution to 145 degrees. Next, we added the amount of water needed to fill the boiler to overflowing with an acid having a dilute strength of 4%, and decided 7900 lb of acid would meet these conditions.

Then we put a "stop" meter in the raw-water feed line to the mixing tank. The meter was set so 85 gallons of water were dumped into the mixing tank for each carboy, 113 lb net, of inhibited muriatic acid, 28 degrees Baumé. The steam-jet heater and mixer raised the solution temperature to 140 F.

FEEDING THE ACID

Once under way, we dumped carboys into the mixing tank at a rate of 30 per hr. We reset the "stop" meter to feed water into the tank at the 85-gallon-per-carboy ratio over the hour.

The circulating pump pulled the acid solution out of the mixing tank and dumped it directly into each of the four bottom waterwall headers Fig. 2, 3. This feed established the flow of the inhibited acid solution upward through the boiler and out through existing openings on each of the upper steam drums, then back into the mixing tanks. All hydrogen released in the acid cleaning carries out through the 2-in. vent and return lines to the mixing tank. Here it is vented to the atmosphere. Inlet valves to each waterwall header are adjusted to give as close to equal flow into each header as possible. Pumping rate ran about 3000 gph.

After dumping each fifth carboy a sample was drawn from the pump discharge, and tested on the spot. These tests were a must. They did two things: (1) assured us that the acid was at the proper strength (2) were a safeguard against any acid attack at the points of entry into the boiler surface from an excessively strong acid.

It took two hours and ten minutes to fill a boiler to its 7140-gal capacity. At this time we ran our first overflow test. From then on we ran similar tests every 30 minutes. These checks helped us in determining what was going on.

The first test showed a drop in acid strength from 4% at inlet to 2.6% at outlet. From Fig. 4 you can see that acid strength dropped rapidly for the first two hours after the boiler was filled. Along about the 4-hour point this rate slowed down. After 6½ hours from the beginning of overflow, acid strength remained practically constant at 2.25%. So it seeemd to us that reaction with the scale was at an end.

When we stopped the acid-pumping cycle we pulled off the blanks on the blowoff valve flanges and drained out the boiler. The mixing tank changed its role. We filled it with water and 250 lb of caustic soda. The soda we dissolved with our steam during the time it took the boiler to drain out. Then we put back blanks on the blowoff flange.

NEUTRALIZING ACID

We then pumped the neutralizing caustic-soda solution into the boiler and kept adding water to fill the boiler to overflow. The caustic solution was returned to the mixing tank and the pump kept running. Through it all we pulled samples to keep a check on caustic strength. After the boiler had once been filled there seemed no change in strength. So, after two hours, pumping stopped and the boiler was drained.

All boiler manholes were opened and drains left open for a final washing. We went in with a fire hose, taking care to wash as much as possible from a point outside the boiler so there'd be no danger of caustic burns from gas pockets or concentrations in the boiler.

Once this fire-hose washing of boiler and tubes from inside the boiler was completed all blanks and blind flanges came off safety valves, feed and drain valves. And all plugs in the superheater tubes were pulled out. Any asbestos gaskets exposed to acid were removed and replaced.

BOILER RESULTS

A thorough inspection of all boiler parts revealed that all scale was gone, the metal bright and clean. It was so clean that tool marks and boiler tube-expander indentations showed up. No etching of boiler pressure parts could be found.

But on starting up, and for the first two or three days, the silica content in the boiler water tested very high. It was assumed that, except for silica, all the scale had been dissolved by the acid. This must have stayed behind in an indiscernible, honeycombed structure, very thinly covering boiler surfaces. Once the boiler went back on the line the silica went into the boiler-water circulation.

As soon as we had finished the boiler cleaning and before we put a unit back into service, we Apexiorized the boiler drum. This conditioned the boiler surface and protected it against oxygen, corrosion or direct adhesion of scale.

Our first acid-cleaning experience, just described, took place as long ago as December 26, 1947. Results were so good that we put all the boilers through the same procedure. Finally we got so good at acid cleaning we could do the job and have a boiler back on the line in a little over 25 hours. Our direct out-of-pocket costs amounted to less than a penny per pound of rated steaming capacity.

All in all, we are sold on acid cleaning for internal boiler scale removal. We think it is practical and requires only normal precautions, backed up by the knowledge and technical assistance available in the usual pulp mill.

Quick Check on Structural Steel

► WHEN YOU PLACE AN ORDER for a structural steel you usually specify what you want. But can you check on what is delivered? A quick, fairly easy way to check finished steel is spark testing. It requires a small grinder with a precision wheel, made especially for spark-testing service, and a knowledge of sparks.

Wheel rotates at 15,000 rpm while idling. When you hold it against any steel, wheel speed drops to about 8000 rpm. Under this high-speed contact, a spray of sparks shoots off the steel like a flow of water. These sparks tell what makes up the steel.

Thus, different carbon-composition steels give off sparks of different shapes. In general, the lower the carbon content, the larger the spark.

When you add manganese, molybdenum, chrome, nickel or some combination to a basic steel, the spark changes its character. With molybdenum you get an orange, arrowlike spark going off the end of the main spark body. Manganese appreciably brightens the whole spark. Chrome dulls it.

Usual structural steel is a low-carbon one, of about 0.06 to 0.18 carbon. Sparks coming off the test wheel are large, far apart, and look like a leaf's skeleton.

R J KEMBEL *Bethlehem, Pa.*

Here's a story* on oiling ball and roller bearings, with a few tips on what applications are best handled with oil rather than grease. Then there's a quick outline on applicators for . . .

Oil Lubrication of Antifriction Bearings

► GREASE AND ANTIFRICTION BEARINGS always seem to go hand in hand. Yet there are many applications, and in ever-increasing numbers, where oil works better than grease. We won't go into considerations of the bearing designer and lube engineer except to say oil is generally more satisfactory for high speeds and high temperatures. Keep this thought in mind where antifriction bearings are used in a high ambient or considerable heat is conducted into the bearing.

Viscosity of lubricating oils varies over a wide range—from virtual water-fluidity to a product close to sirup at room temperature. Viscosity choice depends mainly on speed, maximum operating temperature and bearing seals. As a rule of thumb, high-speed average-temperature conditions require a very fluid oil to reduce internal or molecular friction. Under high-temperature service and usual consequent reduction in speed, oil viscosity must be increased. Often specially refined steam cylinder oils are best.

Most authorities agree that a ball- or roller-bearing lubricant should (1) reduce friction between bearing's sliding elements (2) reduce rolling friction or rolling resistance (3) prevent rust and corrosion of parts (4) dissipate heat generated in and conducted to bearings (5) keep out contaminating materials. We might add that since unit pressures between rolling elements and raceways are extremely high, it is questionable whether an unbroken oil film can be maintained in the pressure zone.

Sliding friction in ball and roller bearings is the result of rubbing action of balls or rollers against their separators, plus slippage of moving elements. Rolling friction or rolling resistance is a much more involved phenomenon and results from deformation of rolling element and raceways under load.

Sum of forces that resist motion in an antifriction bearing is called friction torque. It is a function of: (1) bearing design and load (2) viscosity, quantity of oil in bearing and bearing speed. The second component increases with any increase in quantity or viscosity of oil.

Oil Viscosity. It's agreed that operating speed determines to a large degree the viscosity of oil to be used. Now *Speed factor* is a term that helps link antifriction bearing speed with oil viscosity. We may define it as the product of bearing speed in rpm and bearing bore in millimeters. Keep in mind that energy lost in a ball or roller bearing is proportional to the product of friction torque and speed. Hence the importance of selecting oil of proper viscosity. And, to repeat ourselves, friction torque increases with increased viscosity or quantity of oil in the bearing.

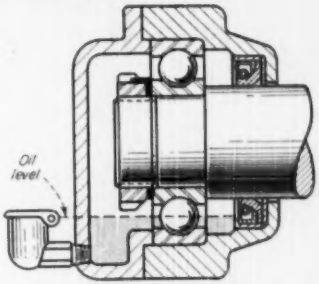
Ambient temperatures must also be considered in determining proper viscosity. This comes into the picture since viscosity of petroleum oil decreases with temperature increase. Thus, oils with higher viscosity are required for high-temperature operation.

Another consideration is temperature fluctuation. Some bearings operate over a wide temperature differential, often the result of weather exposure. Here it is usually well to use different oils for winter and summer.

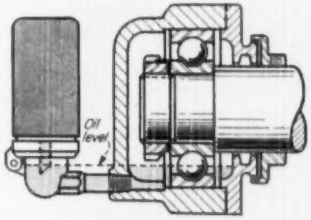
But some machinery is constantly exposed to a wide temperature differential. We know oil viscosity changes with temperature. Oil-viscosity's rate of change with temperature is known as *Viscosity index*. The higher the *VI*, the lower the rate of change in viscosity with temperature. So with bearings operating over

* This article was prompted by J. P. Critchlow's paper, "Oil Lubrication of Ball and Roller Bearings," presented before the 1949 annual meeting of the ASME.

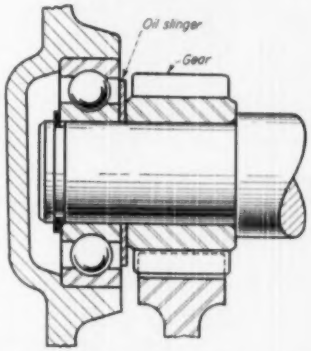
OIL APPLICATORS FOR MODERATE-SPEED WORK



1 Oil cup okay for moderate-speed job. Keep oil centered on the lowest ball



2 Constant-level oiler holds much oil; hence it needs but little attention

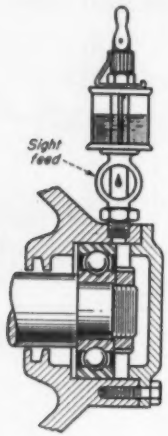


3 Oil splash-fed from gears. Slinger prevents over-lubricating bearing

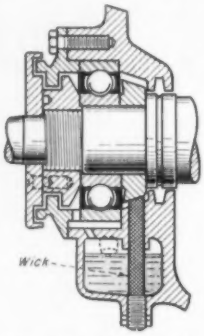
Factors That Govern Lubricant Selection

1 Speed of the bearing
2 Operating temperatures
3 Actual bearing load
4 Atmosphere conditions
5 Lube-application method

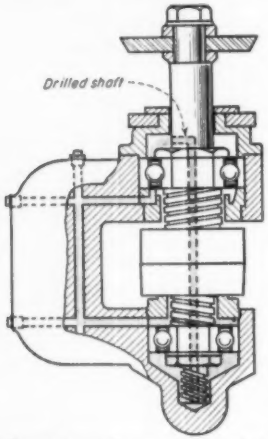
WICK-FEED AND CIRCULATING-OIL METHODS



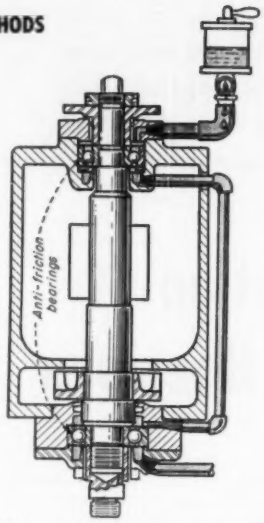
4 Sight gage assures operator oil is feeding into antifriction bearing



5 Oil from lower chamber blown into mist, through bearing, then to sump

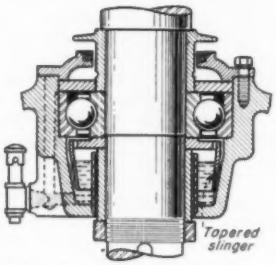


6 Screw-pump forces oil through hole in shaft to point above top bearing

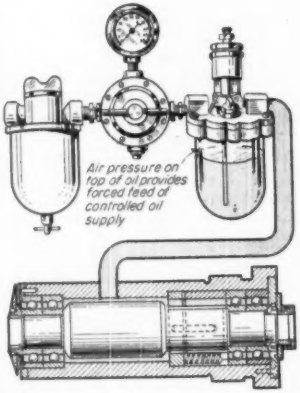


7 This sight-feed oiler is suitable for high-speed bearing applications

OIL-MIST LUBE SYSTEMS



8 Tapered slinger, clamped to shaft, sprays or atomizes oil to bearing



9 This unit holds air pressure steady, filters then supplies oil-mist lube

a wide temperature range it is mighty important to select oil with minimum viscosity index of 90.

Now let's look at the other side of the picture. Many bearings operate under zero F. For such conditions oil should have a *pour point* below the bearing's lowest starting temperature. For really low temperatures—say, below −50 F—it is usually necessary to have lubricants specially developed for this low-temperature operation.

Determining Viscosity. Give special consideration to lubricant selection where bearings operate at a high temperature. High operating temperatures may be considered as anything over 175 F. Remember, petroleum oils oxidize when exposed to air and their oxidation rate about doubles for each 20-F rise. All oxidation results in sludge, gums, varnishes, etc. It goes without saying that these products interfere with efficient bearing operation. That's why this matter of resistance to oxidation is mighty important when we run into high temperatures.

Generally speaking, when speed, bearing size and operating temperature are known, optimum viscosity can be determined. Now a word about that chart, Fig. 10, originally prepared by New Departure, division of General Motors Corp. It takes into consideration all the above factors and is a good working guide for determining oil viscosity. Let's put it to work. To determine proper oil viscosity for a 20-mm ball bearing, at 10,000 rpm and 160 F, multiply 20x10,000, giving a speed factor of 200,000. Then read across from 200,000 to the diagonal line; at that point drop down to the line marked 160 F. You find that the oil recommended should have saybolt viscosity of 250 sec at 100 F.

Remember, this chart does not cover all conditions. Where points fall outside the lower curve, use one of the so-called spindle oils having a saybolt universal viscosity of about 60 sec at 100 F, and a VI of about 100. Where operating temperatures are below 0 F and above 200 F, they require special study for lubricant selection.

Operating Conditions. Next item is what atmospheric conditions the bearing will operate under. Dust, dirt, metallic particles, etc, cause bearing failure in a short time if they get into the working area. This problem can generally be boiled down to a matter of sealing. But mechanical sealing has its limitations and for extremely dusty conditions a grease is usually best. This is another consideration when evaluating grease or oil as a bearing lubricant.

Probably the last factor that affects bearing-lubricant selection is the method of applying it. Oftener than not, the

lubricant is selected first and the application method is designed to suit it. Actually, the oiling method should be determined on the drawing board.

Lubricators. A wide range of devices is available for applying automatic or controlled lubrication to bearings. These run from the ordinary oil cup to the complicated automatic and circulating oiling system. Where the oil volume required is low and first cost is a major consideration, many variations in the ordinary oil cup can be utilized efficiently. But where bearing operation is continuous, oil volume required is large, operating temperature is high, and constant lubrication vital, consider a centralized oil-lubricating system. Yes, such systems usually do entail higher first cost, but that is compensated for by long-time economies.

Where gears carry oil to the bearing, a slinger is usually near it, or bearing is shielded instead of being open. These devices prevent excessive oil entering bearing, besides acting as shields against outside contamination. Extreme-pressure noncorrosive oils are most effective, especially for heavy-duty gears.

Sight-feed oilers are designed to control oil flow to the bearings. They normally fit into the picture for high-speed applications where oil flow is extremely small. They can also be used on large circulating systems where oil flow is quite large.

A common and efficient oiling device is the wick-feed oiler, which probably has more variations than any other type. With modifications, they can be used over a wide speed range. Likewise, oil feed can be controlled by size and number of wicks.

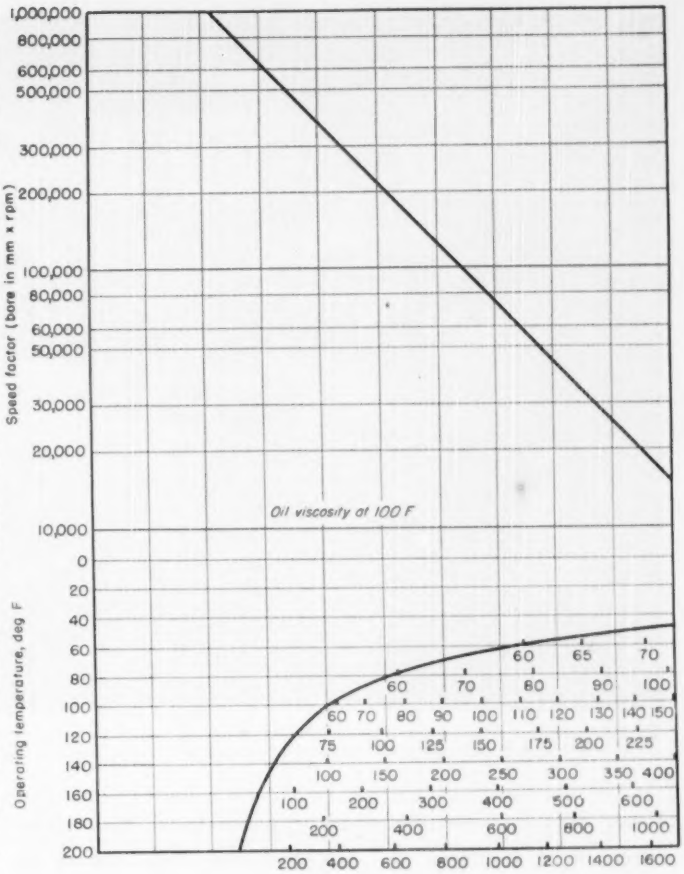
Generally speaking, a circulating system is the most efficient lube system and also the most costly. Where dozens of like bearings on a machine operate continuously under high-temperature conditions, a circulating system should be used—for example, the dryer bearings on a modern paper machine where continuous operation is imperative and ambient temperatures are mighty high. On such an installation there might be well over a hundred bearings served by the same lube system.

Typical circulating system is capable of supplying between two and three pints of oil per minute per bearing. This allows about 1½ to 2 hr for settling time. In addition to the sump, there are pumps, suitable filters, coolers, heaters, etc. for adequately cleaning the oil and returning it to the bearings at the proper temperatures. Oil temperature to the bearings is usually between 120 and 140 F. Return temperatures are 160 to 185 F.

Oil Mist. Mist systems have been quite successful in controlling the volume of lube fed to the bearing on a high-speed job. Usually such systems are used with bearings operating at 30,000 to 100,000 rpm and over.

In a nutshell, the oil-mist system is designed to break up the oil droplets into a fine mist, using air as the carrier. This principle, which had been used for years in lubricating steam engines and air tools, has been adapted for high-speed grinding spindles and other high-speed bearing installations.

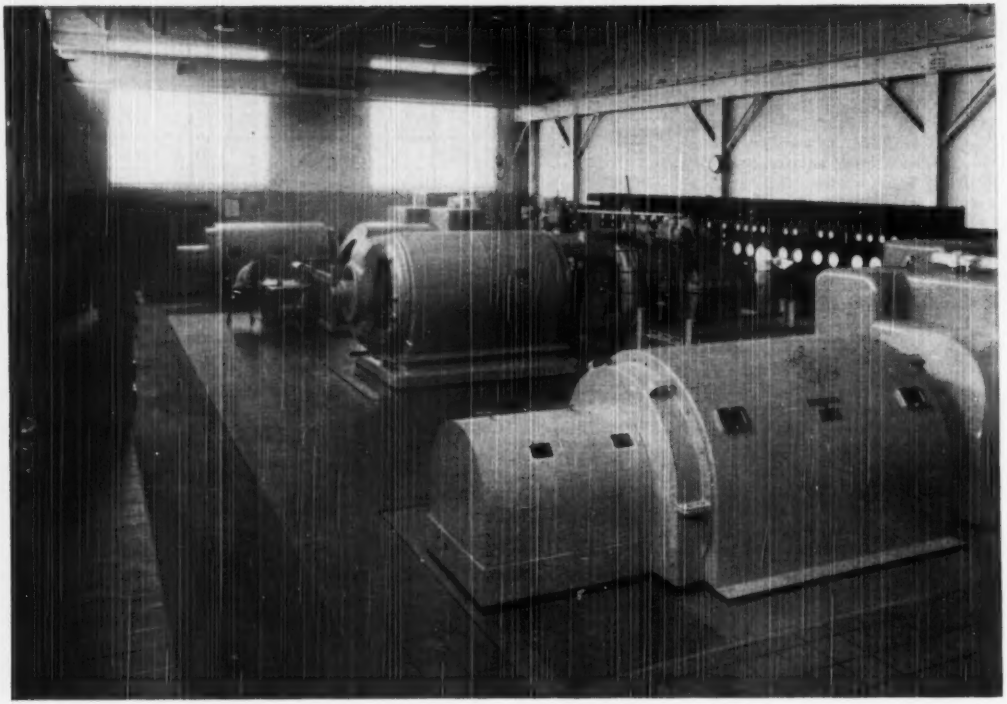
Fig. 8 and 9 show a few oil-mist systems now in use. Some are contained in bearing housing and use a ring to carry oil into upper assembly. There it makes contact with a slinger that tends to atomize the oil. Other systems use a unit apart from the bearing, forming the air-oil mist. Fig. 9 shows such a system.



10 Chart simplifies viscosity determination for bearings operating under various conditions. *Speed Factor* is product of bearing speed and bearing bore in mm

These Are Causes Of Early Bearing Failure

1 Improper handling of bearing
2 Misalignment and poor mounting
3 Bearing not right size
4 Foreign material in bearing
5 Corrosion and vibration
6 Improper lubrication
7 Stray current through bearing
8 Defective materials used



1 Any two of the three turbines shown above can carry the plant load. A tie with the power company makes an even more flexible system. One turbine generates at 2300 v for remote electrical loads, the others deliver energy at 600 v

Paper mills find electrical loads growing faster than steam loads. P H Glatfelter Co, Spring Grove, Pa., tackled its problem by modernizing the plant, using flexible electrical-distribution system, higher-pressure boiler, and found . . .

Byproduct

► WHEN AN ALERT MANAGEMENT authorizes plant modernization and improvement it wants its decision backed up by resulting economies. P H Glatfelter Co at Spring Grove, Pa. has seen its decision so justified and the predictions of its engineers realized. For with steam and electric loads practically unchanged the new plant already shows a saving of $3.22 for fuel and power, per ton of paper produced. With increased production even greater savings should result.

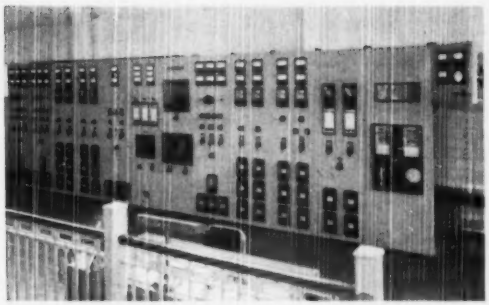
This company has, since Civil War days and unto the fourth generation, followed a policy of sound planning and constant effort to keep abreast of the times. Each addition to equipment and buildings was laid out with an eye to the future. From the start maintenance, cleanliness, good appearance received top attention. At no time did steam and power plants lag behind in these programs. Boilers gave way to higher-pressure units as the boiler industry made them available. Extraction turbines and electric drives followed engines. Higher voltages and transformer load centers replaced the distribution system when it outgrew practical limits of low-voltage service.

This latest modernization takes advantage of lower-pressure and -temperature boilers still serviceable by making them part of the new over-all scheme. The high degree of flexibility required in today's pulp and paper mill—24-hr days, 7-day work weeks, wide load swings—guided the power program and new boiler selection. Success of this planning is measured by the ease with which operators, equipment have met all demands that have occurred to date.

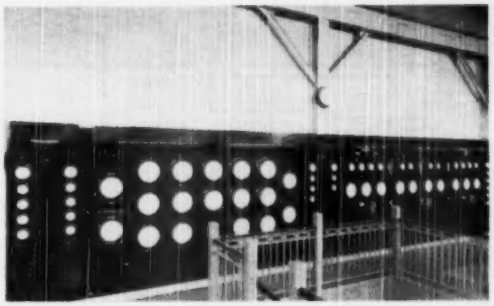
A pleasing arrangement of equipment coupled with quarry-tile floor and an attractive color scheme in painting add beauty to serviceability.

Electrical Requirements. Load under the old setup divided about evenly between the local public utility and a 3000-kw single extraction and condensing turbine. Turbine operated at 305 psi. 500 F at the throttle and extracted at 30 psi. Both the utility and the plant turbine paralleled on a 600-v 3-phase bus. The bus along with its oil circuit breakers had reached the limit of its ampere carrying and interrupting capacity.

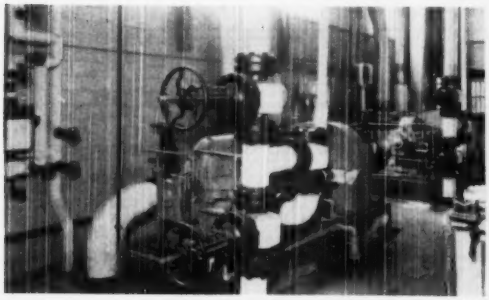
Under the new setup electrical energy is generated at two voltage levels—600 v for points near the turbine room, 2300 for those more remote.



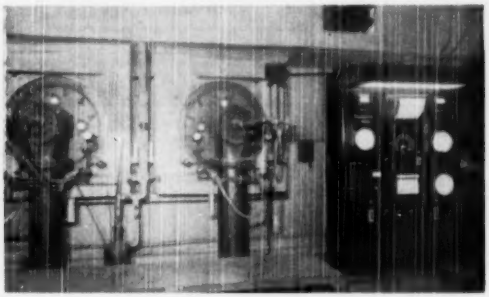
2 Electrical board has switches for generator-breakers, power company tie, 2300- and 600-v feeders and tie transformers



3 All steam for turbines or process is metered above. Turbine condenser absorbs sudden drops in extraction steam



4 Feedwater pumps, above, and in Fig. 6 supply high-, medium- and low-pressure boilers as well as 125-psi economizers



5 Front of the new 600-psi boiler shows the pulverized coal or oil burners and a separate control panel for this unit

By **SAMUEL BLUM**, *Chief Engineer, H M Wilson Co, and*

NEVILLE B ROHRBAUGH, *Plant Engineer, P H Glatfelter Co*

Power Betters Paper Mill Service

One new 6000-kw extraction-condensing turbine-generator delivers current at 2300 v. It runs at 325 psi, 575 F on steam from older boilers, but turbine can draw from the 600-psi line through reducing valves, Fig. 6. If desired later on, it can operate at 600 psi, 625 F at the throttle. Automatic extraction takes place at 30 psi.

A second new 4000-kw unit receives steam at 600 psi, 625 F; extracts automatically at 150 psi; exhausts at 30 psi. It generates at 600 v. The third turbine, an existing 3000-kw unit, takes steam at 325 psi, 500 F; extracts automatically at 30 psi. Its electrical output is at 600 v.

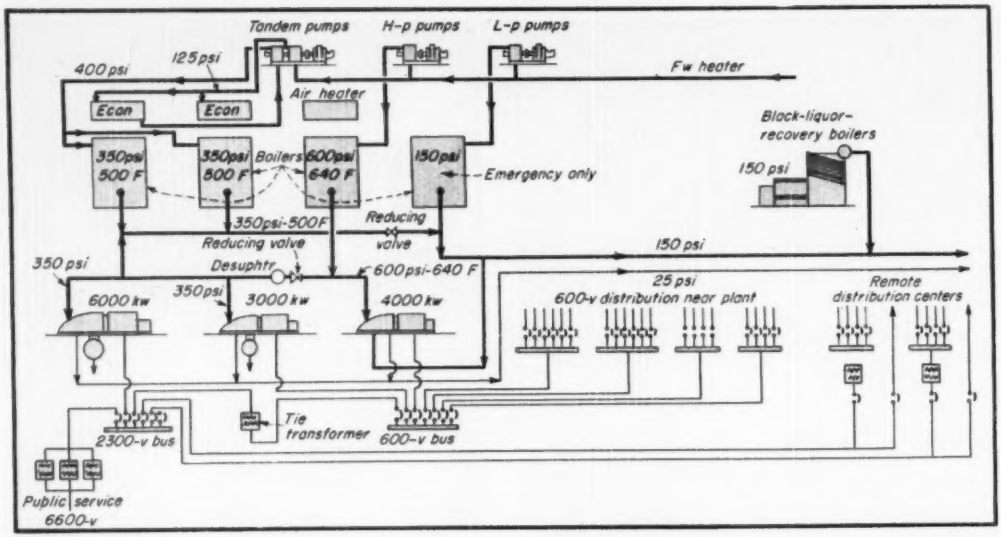
Normally the 4000-kw extraction-backpressure unit carries about 3700 kw. The 6000-kw extraction-condensing machine assumes remaining load, roughly 4000 to 5000 kw. The 3000-kw extraction-condensing turbine-generator, along with the power company's 4500-kva bank of transformers, is standby for either 600- or 2300-v system needs.

Two-way transformers connect both 600- and 2300-v distribution systems to give maximum continuity as well as flexibility. Local utility parallels on the 2300-v bus. A load limiter, which reacts on either condensing turbine, holds energy supplied by the utility to a predetermined setting. If steam for process at 150- and 30-psi levels drops suddenly while electrical load stays up, steam continues through the turbine to the condenser. Thus, condenser takes any load swings where extraction-steam demand falls off.

Any two of the three turbines, Fig. 1, now in service can carry plant load. The power-company tie makes the system even more flexible. The governing mechanisms permit any two turbines to operate as if they were a single unit, either alone or in parallel with the power company.

This mechanism gives flow preference to the 30-psi system, the 150-psi next, and condenser last. One of the two machines operating at any given time has the 30-psi extraction flow fixed. Second turbine responds to 30-psi pressure control. The 150-psi extraction also comes under control but receives its supply after the 30-psi demand is met. Any shortages are made up through a 325- to 150-psi reducing station, Fig. 6.

Load Changeover. New turbines and switchgear occupy a new building away from the old turbine room. This move was made so mill operation could continue uninterrupted while new units



6 Steam-flow diagram, above, pictures the elements supplying steam for electrical generation and process. Electrical distribution system layout shows 2300- and 600-v feeders, tie transformers, etc, that result in a highly flexible plant

were being installed. All circuits were carefully laid out and a prearranged schedule set up. As the new turbines came into service a temporary tieline connected new and old buses. Plant circuits were gradually transferred to the new distribution feeders and circuit breakers. When load was all transferred, the older turbine was moved to the new building for emergency duty.

Load Swings. All swings in electrical load or changes in extraction flow are taken by the condensers on one of the two turbines, above. Results are excellent considering the swings in electrical and steam loads that condensers absorb. Extraction pressures stay within ½ lb normally, within 1- 1½ lb with load swings up to 30,000 lb per hr.

Governors hold speed to where frequency remains within plus or minus 0.2% for settled load change and units operating alone. (That is, when tie with utility system is not in effect.) Under sudden load changes as high as 2000 kw on the 6000-kw unit, frequency varies no more than 1.3% with quick restoration. All gages and instruments for three turbines and the distribution flowmeters occupy one large board, Fig. 3, on one side of turbine room.

Circulating water comes from the nearby Cadorus Creek. It returns to a point above the dam considerably away from the intake. In abnormal droughts this water could be sprayed.

Distribution Switchgear. Main electrical control board, Fig. 2, on generator side of turbine room carries (1) control switches for breakers of all generators, power-company tie, 2300-v feed to remote substations, 2300/600-v tie transformers, 600-v feeder to four branch circuit breakers (2) all instruments, graphic and indicating, for current characteristics of bus loads.

Breakers stand in three rows at end of turbine room. One row of nine cubicles has 2300-v electrically operated breakers, and near them the bank of three 1500-kva air-cooled 2300/600-v power-company tie transformers. Second row of seven cubicles houses the 600-v electrically operated breakers. Atop these cubicles is a copper bus of eight bars per phase, arranged hollow-square for low-voltage power. Third or middle group consists of four subgroups, each with six manually operated distribution breakers provided with watthour meters and ammeters.

Steam Supply. Since the last major revision in 1931 steam for plant use had been supplied at two pressure levels, 315 psi and 150. Boiler room held (1) two 80,000-lb-per-hr cross-drum straight-tube boilers pulverized-coal- or oil-fired at 315-psi level (2) underfeed stoker-fired 35,000-lb-per-hr 150-psi unit. Several black-liquor boilers in the pulp mill supplemented the 150-psi steam supply.

When a new boiler became necessary, operations were gone over thoroughly. Digester plant represented a large steady demand for 150-psi steam. If this steam could pass first through turbines before entering the 150-psi header a share of the electrical load could be generated. With this decided, the new boiler was chosen to operate at 600 psi, 640 F instead of 350 psi, 500 F as did the existing boilers.

With this new pressure level, steam to one turbine, the 4000-kw unit, has a greater differential between throttle and extraction for generating electric current. Yet all high-pressure steam does not go through this turbine. A pressure-reducing valve and desuperheating station, Fig. 6, permits delivering the surplus of the new boiler to the 350-psi header.

This new boiler, Fig. 5, is a 3-drum bent-tube unit. It has 12,100 sq ft of tube surface, 3985 sq ft of waterwalls covering all four sides, a tubular air heater of 16,400 sq ft. Furnace volume amounts to 7600 cu ft; heat release, 20,400 Btu per cu ft at the 115,000-lb-per-hr continuous rating. It is fired by two pulverizers each with 7500-lb-per-hr capacity, with coals from 2 to 10% moisture and 55 to 100 Hardgrove grindability. Burner heads carry steam-atomizing oil guns for burning bunker C at starting-up times but they have enough capacity for full-load operation if needed.

A mechanical flyash collector removes dust from the furnace flue gas and delivers it to a pneumatic ash-handling system. All ashpits and other collecting hoppers connect to this ash-handling system. A brick ash bin receives all collected ash for final disposal to trucks.

PRINCIPAL POWER-SERVICE EQUIPMENT

P H Glatfelter Company, Spring Grove, Pa.

STEAM GENERATION AND AUXILIARIES:

Boiler, 1 ..... Riley Stoker Corp
3 drum, bent tube, 600 psi, 640 F, 115,000 lb per hr
Boilers, 2 ..... Foster Wheeler Corp
Revamped — sectional header, straight tube, cross drum, 365 psi, 425 F, 100,000 lb per hr, 11,380 sq ft heating surface, rear wall 290 sq ft
Side waterwalls, new ..... Combustion Engineering-Superheater, Inc
Economizers, cast iron, 13,150 sq ft ..... Green Fuel Economizer Co
Pulverizers, 6, No. 5 Atrita ..... Riley Stoker Corp
Driven by 125 hp — 880-rpm motors
Burners, coal, 6 — No. 4 flare type ..... Riley Stoker Corp
Burners, oil, 6 — steam atomizing ..... Faber Engineering Co
Valves, blowoff ..... Yarnall-Waring Co
Valves, safety ..... Consolidated Safety Valve Div, Manning, Maxwell & Moore, Inc
Water column — inclined ..... Reliance Gauge Co
Valves — feed and check ..... Edwards Valves, Inc
Soot blowers ..... Diamond Power Specialty Corp
Fan, 1 ..... B F Sturtevant Div, Westinghouse Electric Corp
Forced draft, 50,000 cfm — 10.5-in. static pressure
Fan, 1 — induced draft ..... American Blower Corp
90,000 cfm, 400 F, 9.5 in. water, 870 rpm. Driven by 200-hp variable-speed motor
Flyash recovery system, 1 ..... Thermix Corp
Larry, coal ..... Beaumont Birch Co
Valves, coal ..... Stock Engineering Co
Meters, coal spout ..... Bailey Meter Co
Alarms, coal level ..... Bin-Dicator Co
Ash-handling system, 1 ..... United Conveyor Corp
Pumps, boiler feed, 2 ..... Goulds Pumps, Inc
4-in., 6-stage, centrifugal, 400 gpm, 1750-ft head
Turbines, 2, pump drives ..... Westinghouse Elec Corp
Governors: pump, 2, on turbines ..... Mason Neilan Regulator Co
Regulator, feedwater, 1, Copes ..... Northern Equipment Co
Valve, non-return, 1 ..... Golden Anderson Valve Specialty Co
Softeners, water, Zeo-Carb ..... Permutit Co
Heater, feedwater, deaerating type ..... Cochrane Corp
Continuous blowdown ..... Cochrane Corp
Valves, pressure reducing ..... Fisher Governor Co
Desuperheating equipment ..... Swartwout Co
Pumps, condensate ..... Ingersoll-Rand Co
Control, combustion ..... Brooke Engineering Co
Meter, steam flow — air flow, ... Bailey Meter Co
Gage, water level, Eye-Hye boiler ..... Reliance Gauge Column Co
Gage, draft, multipointer ..... Bailey Meter Co
Recorder, CO_2 ..... Hays Corp
Potentiometer ..... Brown Instrument Co
Alarm, flame failure ..... Bailey Meter Co
Meters, electrical ..... Westinghouse Electric Corp
Boards, Gage ..... Falstrom Corp
Platework ..... Connery Construction Co

TURBINE-GENERATORS AND AUXILIARIES:

Turbine, 1, ... Westinghouse Electric Corp
4000 kw, Noncondensing, automatic extraction, 600 psi, 625-F throttle, 150-psi extraction pressure, 30-psi backpressure
Turbine, 1 ..... Westinghouse Electric Corp
6000 kw, condensing, automatic extraction 325, psi, 575 F, throttle; 30-psi extraction pressure 2-in.-Hg abs backpressure
Flowmeters and recorder ..... Brown Instrument Co
Boards, Gage ..... Falstrom Corp
Condenser, 1 ..... Westinghouse Electric Corp
6000-kw unit, 6500 sq ft surface type
Pumps, circulating, 2, ... Westinghouse Electric Corp
Driven by 100 hp, 1160-rpm motors, 4100 gpm, 75-ft head
Pumps, condensate, 2, ... Westinghouse Electric Corp
Driven by 15 hp, 1750-rpm motors, 150 gpm, 150-ft head
Air ejectors, steam jet, 2, two-stage ..... Westinghouse Electric Corp
Valves, relief and nonreturn ..... Atwood & Morrill Co
Oil-filtering system ..... Bowser, Inc

SWITCHGEAR AND INSTRUMENTS:

Main control board, 14 panels ..... Westinghouse Electric Corp
All breakers remote
Switchgear, 2400 volt ..... Westinghouse Electric Corp
Nine cubicles — drawout type
Switchgear, 600 volts ..... Westinghouse Electric Corp
Seven cubicles — drawout type — external copper bus
600-volt distributing center ..... Westinghouse Electric Corp
Consisting of four groups of six air breakers, each provided with watthour meter and ammeter
Transformers ..... Westinghouse Electric Corp
3 — 1500 kva, single phase 2300/550 v
2 — 1000 kva, three phase 2300/550 v
Crane, 15 ton ..... Shaw-Box Crane & Hoist Co
Fire protection for generators — CO_2 ..... Walter Kidde & Co

ENGINEERING SERVICES:

Engineers and constructors ..... H M Wilson Co
Piping contractor ..... Nelson Co
Electrical contractor ..... I Abel & Son
Insulation ..... Philadelphia Asbestos Co
Consulting Engineers ..... H M Wilson Co

Older boilers have had their steaming capacity brought up to 110,000 lb per hr by installation of side waterwalls. Originally they carried only a rear waterwall because of low load conditions at that time. To maintain combustion in a relatively large furnace space at low firing rates required refractory surfaces of air-cooled walls to reflect some of the heat and thereby aid combustion.

Each of these units carries two burners placed side by side in a V, arranged so their flames converge near the rear wall, thus preventing impingement against side walls.

Hoppers are provided under the last pass of the boilers, the economizers and the breeching. Heavy ash particles collect in these hoppers. Tangential entries connect the fan to the breeching and the breeching to the stack so only the finer flyash particles reach the stack. The original 9-ft, 6-in. radial brick stack, 205 ft high, serves the entire plant.

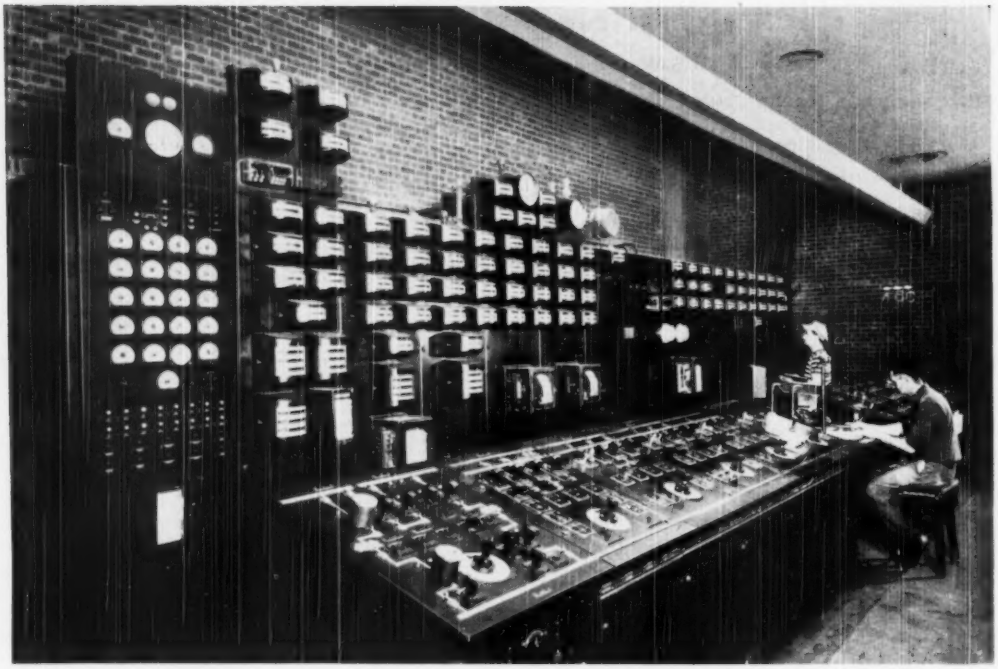
Economizers. The older 350-psi boilers carry economizers that handle feedwater at 125 psi. The reason again goes back to an earlier modernization program when the 350-psi units were installed. The boilers these units replaced, about 20 years old at the time, had cast-iron economizers designed for 250-psi service.

The then new boilers were designed for so low an exit-gas temperature that to include economizers on them promised so little savings that carrying and operating costs would scarcely have been met. Rather than scrap the old economizers, and in view of the cost of new equipment, a plan was worked out to use the old units. Feed piping was rearranged so only 125 psi was put on the old economizers.

Two-unit feed pumps mounted on the same shaft made it possible to deliver 125-psi water to the economizers. One 2-stage unit delivered feedwater, Fig. 6, from the feedwater heater at 220 F to the economizers at 125 psi. The second, a 4-stage pump, boosted pressure from 125 psi, 300 F from the economizer to 400 psi for boiler feed.

These old economizers have been replaced in this most recent modernization with units of essentially the same design. This required only slight changes in supports, ducts, piping.

Control board for the new boiler unit, Fig. 5, carries a full complement of instruments—steam gage, steamflow-airflow recorder, multipointer draft gage, recording feedwater and steam pressure, 6-point potentiometer, boiler-water-level gage, CO_2 recorder, pulverizer and induced-draft fan ammeters, and combustion-control switches.



CENTRAL CONTROL BOARD for primary-distribution system. Section of control board for generators in foreground. It handles six generators, is equipped with audible and visual alarms. Generator board (left background) serves new 13.8-kv unit

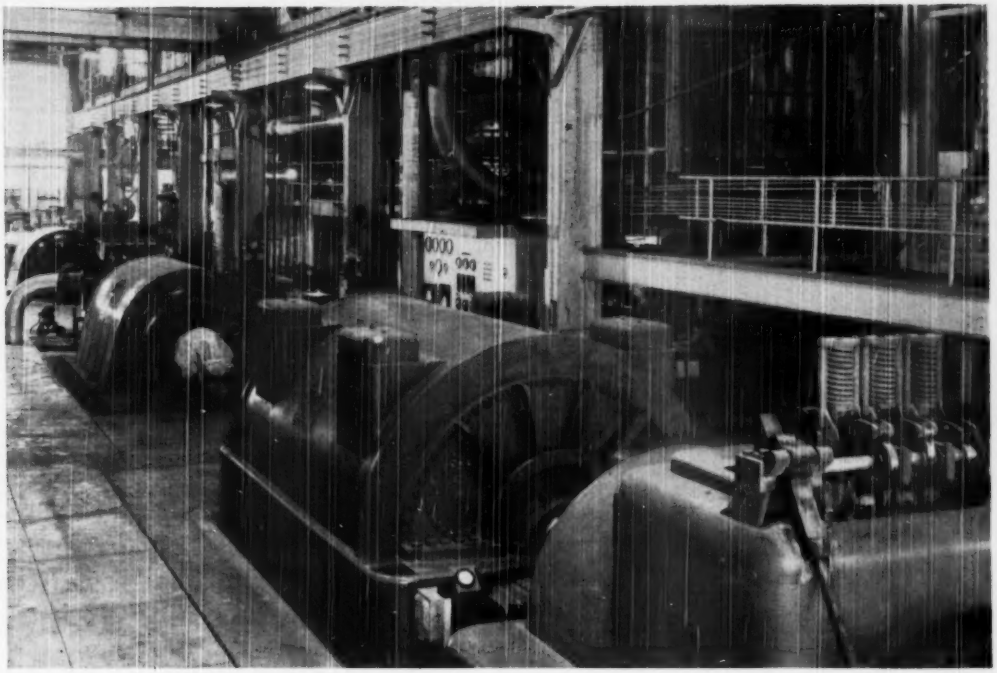
Electrical Distribution System Keeps

Continuous service 'round the clock, maximum reliability and flexible operation are built into the growing electrical system at the Diamond Alkali Co's Painesville, Ohio plant

By **J A HORACEK**,
Electrical Superintendent and
W M AHLSTROM,
Asst Elect Superintendent
Diamond Alkali Company

SWITCHING STRUCTURE built in 1925. Brick walls and alberene slabs used in this isolated-phase double-bus construction

2.3-KV SWITCHGEAR installed in 1939 when first 15,000-kw generator was put in service. Square copper bus rated 4000 amp



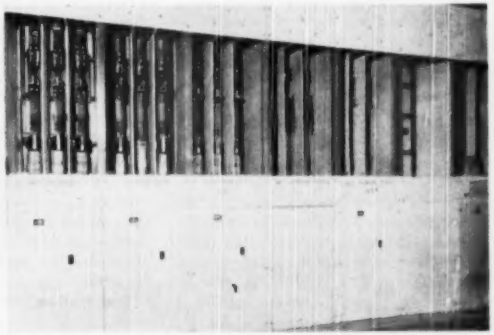
HYDROGEN-COOLED TURBINE-GENERATOR in foreground is newest 15,000-kw addition to generating system at Painesville plant. First unit in background is also 15,000 kw, while last shown is rated at 10,000 kw. All have direct-connected exciters

Step With Increasing Chemical Output

► POWER GENERATION and distribution equipment in our plant has gradually expanded from the inital 1500-kw 230-v dc system, back in 1912, to our present 53,000-kw capacity. In a nutshell, this meant reducing dc generating equipment, and picking up load on ac turbine-generators. Large-scale changes started in 1922. Even at that early date, heavy load growth was anticipated. It was at that time we decided to design all future power installations to minimize rebuilding regardless of load growth.

The year 1923 stands out in our

METAL-ENCLOSED SWITCHGEAR for latest 13.8-kv installation. Interrupting capacity of enclosed breakers is 1,000,000 kva



TYPICAL PHASE-ISOLATED construction used throughout 2.3-kv system. Note current transformers on copper bus structure

METAL-CLAD SWITCHGEAR installed in 1949 for 2.3-kv system. Supplies power to auxiliaries for the high-pressure boilers

INSTALLED GENERATING CAPACITY

Year	Capacity, Kw	Type
1912	1,500	All 250-v dc
1915	2,500	
1916	3,500	
1922	3,000	
1923	5,000	2000 kw, 2.3-kv ac
1925	10,000	
1929	16,000	
1934	24,000	All 2.3-kv ac
1939	38,000	
1949	53,000	15,000 kw, 13.8 kv

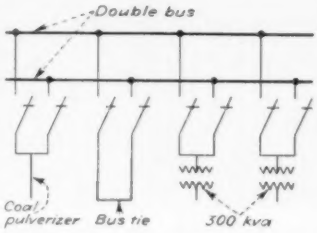
memory. During that year we installed our first 2000-kw 2.3-kv ac turbine-generator. It was a condensing unit designed to operate at 150 psi with 12-psi extraction. And about this same time, generator and feeder switchgear were installed incorporating a double-bus system. Incidentally, this double-bus idea simplified periodic cleaning and servicing of individual circuit breakers without killing the tapped feeder.

We generate practically all electrical power in our own plant. An exception cropped up in 1929 when a 5000-kw connection was made with the Cleveland Electric Illuminating Co.

Let's skip all in-between steps for the moment (see table above) and look at the latest addition to our power-generating system, a 15,000-kw turbine-generator operating at 1500 psi. This machine, installed in 1949, exhausts at 150 psi and generates electrical power at 13.8 kv. Unit is fed from an individual pulverized-coal-fired steam generator. Hydrogen-cooled generator is rated 15,000 kw at 0.5-psi hydrogen pressure. It will operate at 150% of its rating by increasing hydrogen pressure to 15 psi.

Switchgear. In the period between 1934 and 1939 we found the 2.3-kv switching equipment had reached the limit as far as ocb interrupting capacity was concerned. This fact alone ruled out direct connection of another generator without exceeding safe interrupting values of fault current. We solved this one by connecting the next new unit to a separate bus. The existing bus structure was then divided into two sections.

As a result, we wound up with three bus sections, each having its own connected generator. All sections of the bus were then interconnected through



DOUBLE-BUS system allows keeping feeder alive while working on circuit breakers

current-limiting reactors to limit fault current to values that could be safely handled.

Shortly after sectionalizing the bus we considered using metal-enclosed switchgear. Remember, our requirements were based on a double-bus system having an interchangeable feeder braker system. So considering available space and installed cost, in relation to our existing design, we eliminated metal-enclosed switchgear from the picture at that time (1939). As a result, brick construction was again used for switchgear housing. By now power-generating capacity had reached a total of 38,000 kw at 2.3 kv.

Since our operations are normally handled on a continuous basis, there is less than 10% variation between maximum and minimum power demands. Therefore, economy dictated that equipment be installed to serve specific load requirements most efficiently. This reduced surplus generating capacity and installed "spares."

Distribution System. In many portions of the distribution system, service outages were reduced to a minimum by paralleling cables on each phase. When any cable fails the particular 3-phase group where the failure occurred is first determined. That group is then disconnected at each end of the circuit and feeder is restored to service at the reduced capacity. Standard cable used for 2.3-kv feeders is varnished-cambric lead-sheathed having a 5-kv rating.

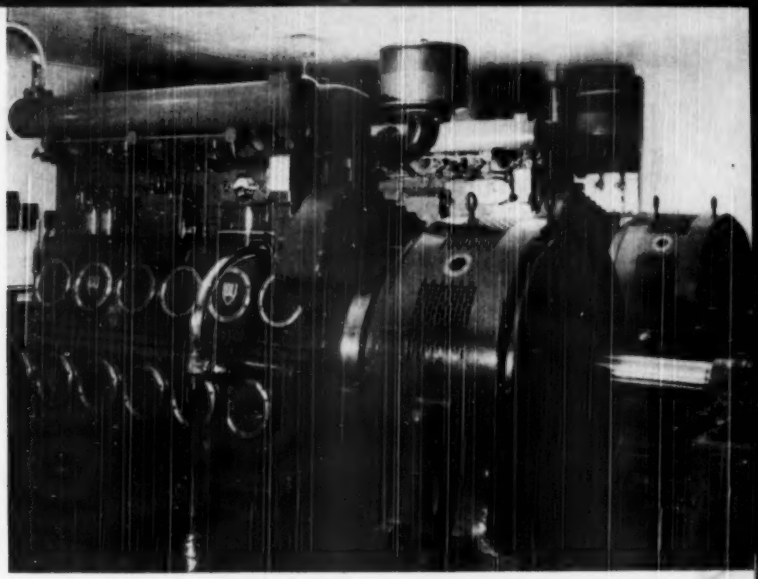
All exposed cable is covered with a double thickness of $\frac{1}{8}$x2-in. fireproofing material impregnated with sodium-silicate solution. This fireproofing material is wound on the cable, the second layer half lapping each turn of the first.

Neutral of 15,000-kva generator connects to ground through the primary winding of a single-phase transformer. Secondary of this 440-v transformer is connected to a resistor. In this way ground-fault current is limited to about 40 amp, in event of a phase to ground false on the 13.8-kw system. Alarm system goes along with this hookup to indicate which circuit has a grounded phase. Since all feeders are normally ungrounded, this feature allows a planned shutdown of the faulted feeder instead of instantaneous tripping when a fault occurs.

When new 15,000-kw 13.8-kv generator was installed, a pilot exciter was considered the best bet because of transmission-line characteristics. But a pilot exciter is often a source of trouble. So in place of this unit a 135-v nickel-iron alkaline storage battery was used with the main exciter field getting its energy from this battery. Main exciter-field current is controlled by voltage regulator.

Our electrical department handles all electrical maintenance, construction repair work. We have installed about 3000 motors ranging in sizes from fractional to 1700 hp. We stock about 300 spare motors to cover periodic replacements and burnouts.

Good air filters, correctly installed and serviced, keep damaging dust and dirt out of your diesel. That means less maintenance, longer engine life, greater reliability. Tyler G Hicks tells you how . . .



INTAKE-AIR FILTERS protect these diesel engines in power plant of a university

. . . Clean Air Keeps Diesels Healthy

► IF SOMEONE PUT SAND in your diesel bearings you'd call it sabotage. And that's just what it would be. Dust in the air your engine breathes can do just as much damage in the long run. If you don't take steps to clean that air, you're guilty of sabotage, too. Fortunately, keeping intake clean is easy with the right equipment, properly installed and serviced. Here are some practical pointers on this job.

Dust Damage. Foreign materials in air are often highly abrasive. If they get into the cylinders, they speed up piston, ring and liner wear. They join up with carbon and gums to form deposits on cylinder walls and in ring grooves. They get in the lubricating oil. At best, this means overloading oil filters; at worst, it means grit in bearings, sludgy deposits in the crankcase, clogged oil lines. In short, foreign materials do no good.

What are these foreign materials? Depending on where the air comes from, it may carry fine sand, soot and flyash, lint, industrial wastes, pollen and other organic particles. Even in supposedly dustfree areas, such as residential districts, air often contains harmful particles in amounts great enough to cause trouble over a period of time. The answer lies in filtering air.

Filter Requirements. The perfect filter would remove all particles (100% efficiency), offer no resistance to air flow, and need no servicing. Reasons for wanting high efficiency are obvious. Resistance comes into the picture because the output of diesel and gas engines goes down as pressure drop in the intake system goes up. Usual practice is to hold to about 2 psi, or up to about 6 in. wg. We'll look at this angle a little later when we talk about intake piping. Right now all we need to know is pressure drop we can take in the filter is limited. Flow resistance of some types of filters goes up in service so this angle must be watched carefully in operation.

There is no perfect filter. Each type has advantages and disadvantages, making selection a compromise. To see what's involved, let's take a look at the several basic filter types and see how they behave in service.

Filter Types. Dry filters use felt as the filtering medium. It is usually arranged to present a large surface area in a small space. Cleaning efficiency runs high—99% or better when felt is new and clean. Resistance to air flow is low at the start (about 0.1 in wg) but builds up as dust collects on the surface. A resistance of about 0.5 in. wg may be taken as the practical limit since beyond this point resistance increases very rapidly. Some form of cleaning is then needed.

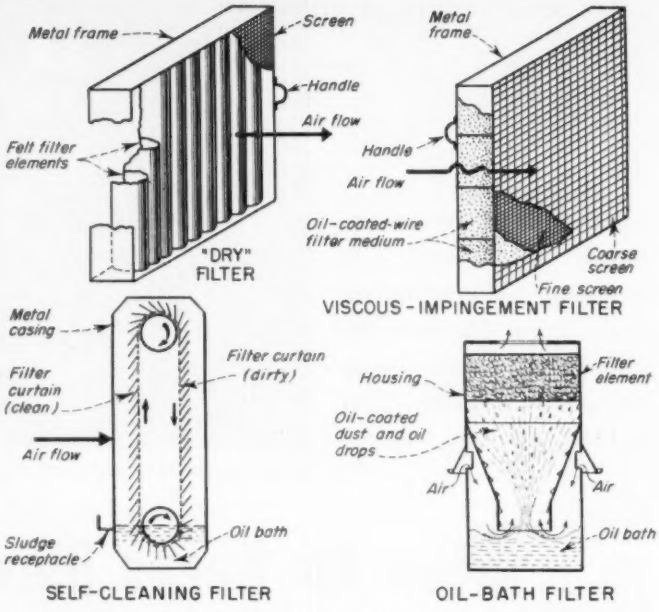
Viscous-impingement filters contain crimped wire strands, usually packed so free air space gets progressively less in the direction of flow. Strands are coated with oil to catch dust particles impinging on them. Efficiency runs lower than with dry filters, about 97-98% on atmospheric dust. Resistance is also somewhat higher, being in the neighborhood of 0.25 in. when clean. It increases more slowly than in dry filters, however. Good practice calls for cleaning when pressure drop gets to about 0.5 in. If allowed to go beyond this point, say to 3 or 4 in., oil on the wire strands gets dust-soaked and little or no further cleaning is done.

If we accept a somewhat higher resistance at the start, we can have filters whose resistance hardly changes in operation and which need less servicing. Filters of this kind are sometimes called "constant effect" filters. One type uses the viscous-impingement principle, but is automatically self cleaning. The filter curtain, consisting of oil-soaked baffles, is moved intermittently by a motor and timer, passing through an oil bath at the bottom of the casing. This removes dust from the filter curtain and recharges it. Efficiency of such a filter runs about the same as the washable viscous-impingement type. Resistance stays constant, usually somewhat less than 0.5 in. Only service needed is occasional cleaning of sludge from oil bath and refilling to hold proper level.

Many of today's diesel intake filters are the oil-bath type. The diagram shows

TYPICAL CAPACITY FACTORS FOR DRY FILTERS

Type of area, dust conditions, hours of plant operation	Capacity factors %
Residential districts	95-100
Industrial districts, light dust loads, up to 16 hr a day	95-100
Industrial districts, moderate dust loads, up to 8 hr a day	85-95
Industrial districts, heavy dust loads, intermittent service	80-85
Industrial districts, light dust loads, continuous service	75-80
Industrial districts, moderate dust loads, up to 24 hr a day	65-75
Industrial districts, heavy dust loads, up to 16 hr a day	60-65
Industrial districts, heavy dust loads, continuous service	55-60
Dust-storm areas	50-55



FILTER TYPES: Dry and viscous-impingement designs have low initial resistance, but it builds up; self-cleaning and oil-bath designs show essentially constant values

the principle of operation. Entering air is directed to impinge on oil at high enough velocity to pick up oil droplets and carry them to the filtering medium above. This constantly washes and recharges the filter element, which works on the viscous principle. Some dust particles are thrown out as air changes direction, but most of the cleaning job is done in the filtering medium.

Commercial oil-bath filters have a more complex construction than that of the diagram. They reach extremely high efficiencies—well over 99%—and require little servicing. Sludge must be removed occasionally and oil added. Because of the need to pick up oil, resistance runs higher than in other types. Even a simple design may need a pressure drop of about 1.0 in. and more complex designs may run higher. Like the self-cleaning type, however, resistance stays essentially constant.

Filter Installation. Filters for small engines may be, and often are, placed close to the engine, drawing air from the engine room. For large engines, where volume of air intake is great, this arrangement makes it difficult to control engine-room ventilation. It may also make for a dusty engine room. Wherever possible, filters should be located outside the plant building. The diagrams show some of the many possible arrangements. Top row illustrates hookups where no separate intake silencers are used. Some filters and their housings are designed to have a silencing effect. Lower row of sketches shows layouts for filters used in combination with separate intake silencers.

Top requirement of a good intake installation is freedom from restriction of air flow. Locate the filter in an open area away from dust, moisture and heat-producing apparatus. If possible, have the intake on the north or coolest side of the building.

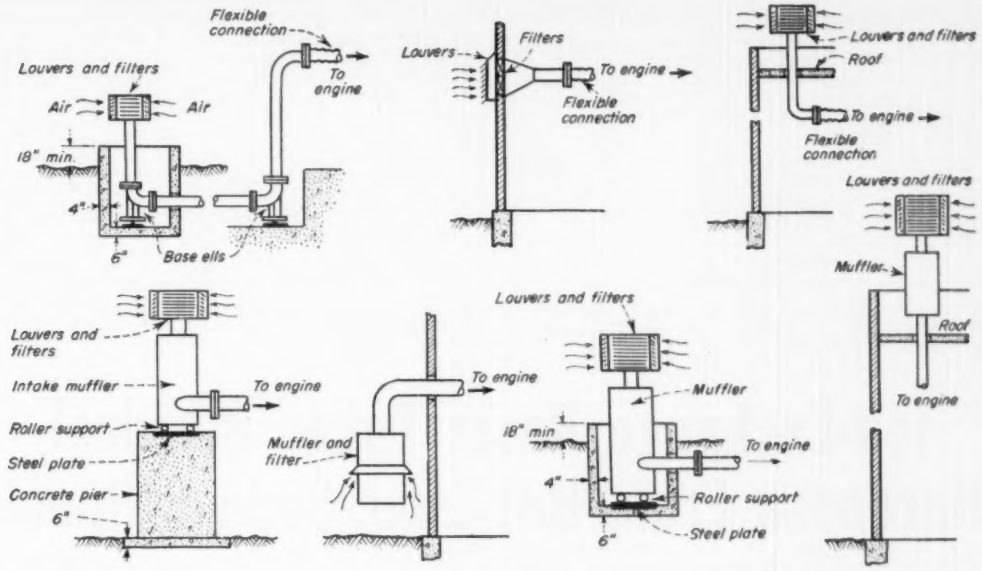
Intake Piping. Between the filter and silencer, and the engine, the intake pipe or duct must be liberally sized to prevent excessive pressure drop. Volume of air needed per rated bhp varies with type of engine, ranging from about 2.2 to 5 cfm per bhp, at 60 F. Taking a figure of 3 cfm per bhp, a 1000-hp engine running at full load needs 3000 cfm. To draw this through the intake pipe and into the cylinders takes part of the engine's power, so we can see the need for keeping resistance as low as possible.

Piping size is usually found by assuming a velocity (usually between 50 and 100 fps) and a diameter. Pressure drop is then calculated for the actual pipe length, making proper allowance for bends and fittings. Assumed pipe size may then be adjusted according to whether the pressure drop is higher or lower than good practice. Never should intake duct size be less than the intake manifold opening. In fact, it is a good idea to increase the size for runs longer than about 10 ft. A rule of thumb calls for increasing duct diameter by one inch for every 10 ft of length. Remember, it is better to have the intake line oversize than undersize. Since bends and fittings introduce considerable resistance, use long-radius type whenever possible.

Engine-air requirements are usually stated at 60 F. Higher temperature means that more air must be handled. For this reason, keep intake lines as far as possible from exhaust lines and heat-producing equipment. If this can't be done, insulate the lines.

Usual provisions for support and pipe expansion are necessary. It's customary to install a flexible connection close to the engine.

Filter Maintenance. How often filters must be cleaned depends on the dust-loading of the air, and the dust-



FILTER INSTALLATION: Typical filter and intake piping arrangements for filters alone (top row) and for filters with separate intake silencers (bottom row). Make sure pipe is safely supported, with provision for expansion and vibration

holding capacity of the filter. On the basic types described, the dry filter has lowest dust-holding capacity, followed by the viscous-impingement type. Capacity of self-cleaning and oil-bath types is about on a par and much greater than the other two. As an example of the effect of dust-holding capacity, consider a viscous-impingement unit and an oil-bath unit handling the same air volume under the same conditions. The viscous-impingement unit, with its lower dust-holding capacity, would require cleaning six to eight times as often as the oil-bath filter.

Dry filters may be vacuum-cleaned or blown clean with compressed air. If dusts are oily, dry-cleaning may be necessary. To clean viscous-impingement filters, remove one cell and replace it with a spare clean one. Soak the dirty unit five minutes in a washing-soda solution, then rinse, and allow to drain. Next, dip it in a tank of charging oil. Finally, let it drain at least 12 hours before putting it back in service. As previously mentioned, self-cleaning and oil-bath filters need only removal of sludge and refilling of oil.

Filter Selection. Which filter type best suits a particular installation depends on kind and amount of dust encountered, size of engine, efficiency and resistance requirements, initial and maintenance costs. With high dust loadings, for example, dry filters would require extremely frequent attention because of their relatively low dust-holding capacity.

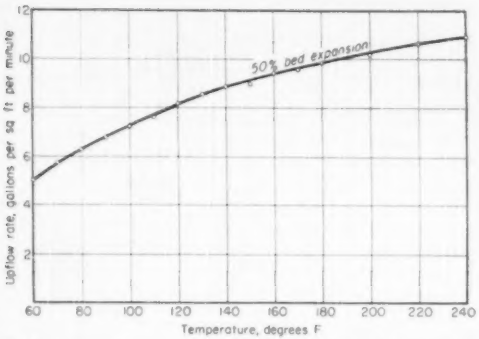
Dry and viscous-impingement filters come in several standard sizes with capacities from about 800 to 1000 cfm. Individual cells may be combined to give the total capacity needed. Because cost of electrical mechanism, oil-tank, etc. of self-cleaning filters does not decrease in proportion to size, this type rarely finds application below about 3000 cfm. By combining units, capacities up to 100,000 cfm, or more, may be obtained. Oil-bath filter capacities range from about 400 to 5000 cfm, and up, depending on unit diameter.

Typical Example. Let's assume an engine requiring 3000 cfm at full load. It operates in an industrial district with light dust loads, and runs continuously. How do we determine filter requirements?

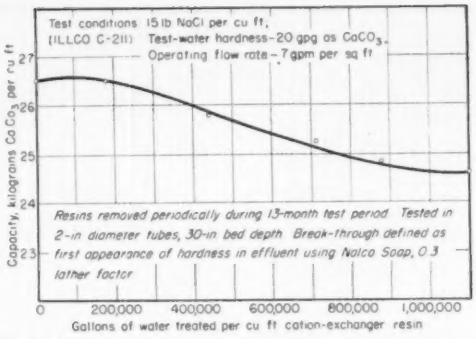
A typical dry-filter cell, 20x20x7 in., has a maximum capacity rating of 800 cfm. Four of these units seem suitable. Operation at maximum capacity is not usually recommended, however, because maintenance costs tend to be higher. The table gives capacity factors for this type of filter. For the assumed conditions we find we should have sufficient filter area to permit operation at about 75-80% of maximum rating. Taking a capacity factor of 75%, we get 3000/0.75=4000 cfm capacity needed. Therefore, 4000/800, or five cells, are actually needed.

In an actual case, of course, engine-air requirements would be obtained from the builder. Filter ratings, and capacity factors, if needed, come from manufacturer's specifications. General procedure would be the same, with final choice of type depending on initial and operating costs. Regardless of type chosen, weather louvers are used if air is drawn from outside. Screens in front of filters keep out birds and large insects.

Why Filters? A 1000-hp engine, using 3000 cfm of air carrying 4.0 grains of dust per 1000 cu ft, would draw in 2.47 lb of dust in 24 hr, or about 740 lb in a 300-day operating year. A 98%-efficient filter cuts this dust intake to about 15 lb per year. Effect on engine wear and maintenance costs is obvious. A diesel's diet is mostly air, and the cleaner it is the better the operation.



1 As temperature goes up water viscosity decreases, so flow rate must be increased to get proper bed expansion


Test conditions 15 lb NaCl per cu ft,
(ILLCO C-211) Test-water hardness-20 gpg as $CaCO_3$
Operating flow rate-7 gpm per sq ft
Capacity, kilograins $CaCO_3$ per cu ft
Resins removed periodically during 13-month test period. Tested in 2-in diameter tubes, 30-in bed depth. Break-through defined as first appearance of hardness in effluent using Nalco Soap, 0.3 lather factor
Gallons of water treated per cu ft cation-exchanger resin

2 Stability curve of resin operating on the sodium cycle that treats water from a hot lime-soda softener at 228 F

Ion-Exchange Resin Takes Residual Hardness From Hot Lime-Soda Effluent

Laboratory and pilot-plant tests show there's a polystyrene resin that offers promising results as an ion exchanger for use on hot solutions. Here you learn how it stands up and removes residual hardness from hot-process lime-soda effluent

By

C H PAGE, *National Lock Co*

JOHN F WANTZ, *Illinois Water Treatment Co*

► To GET BEST RESULTS from a hot lime-soda softener requires frequent readjustment of the chemical feed. Even then the effluent contains a slight residual hardness that normally must be removed by some form of supplementary treatment.

Early Studies. At National Lock Co, when discussing a method of after-treatment to follow hot-process lime-soda, we decided to experiment with an ion-exchange softener operating on the sodium cycle. Up to this time, no ion-exchange material had been available that would stand up in hot water, but laboratory research work on a new polystyrene-type resin showed promising results over a wide range of temperatures. Prolonged tests under high temperature (212 F), high and low pH, and oxidation by chlorine proved this material offered possibilities for softening the lime-soda effluent to eliminate after-precipitation in feed lines, pumps and boilers.

After the laboratory tests on C-211 resin were studied, an agreement was made whereby the Illinois Water Treatment Co would furnish the equipment and the National Lock Co would operate a pilot plant so both companies could study chemical and operational results.

Plant Equipment. At that time, this plant consisted of four Connelly 225-psi 4120-sq-ft watertube boilers. Daily load on the four units ranged from 1,250,000 to 1,600,000 lb of steam. Feedwater makeup averaged 50 to 60%. Well water, Table I, the source of makeup, was treated in a 3000-gal-per-hr hot-process lime-soda softener that produced an effluent containing 1¼ to 1½ gr-per-gal hardness. About 5 lb of hexameta-phosphate were used daily to hold a phosphate concentration of 40 ppm in the boilers.

Pilot Unit. Test ion exchanger consisted of a 24x72-in. softener using 8.5 cu ft of resin, which was installed in October 1947. It was designed to soften 850 gal per hr of lime-soda-treated water at 232 F.

Part of the lime-soda effluent was bypassed through the test unit for final softening, and then used exclusively for makeup on two of the existing boilers. High capacity of the exchange material held regeneration down to once a week. At this time, the unit was taken out of service, backwashed, brined and rinsed. This operation cycle required one hour. A summary of operation, Table II, shows that residual hardness in the hot-process lime-soda effluent was consistently reduced to zero (standard Boutron & Boudet soap test).

Initial operation of the pilot plant was placed on a normal softening cycle with regeneration every six days. This cycle was chosen for both test and plant convenience without regard to total softening capacity, which was greater. Regeneration of the test unit included a thorough backwash, brine draw and rinse to zero hardness. Periodic check of the resin softener indicated the effluent contained from 6- to 8-ppm hardness just before regeneration. Investigation revealed the exchange bed was contaminated with lime deposits, caused by after-precipitation. They were not being removed during normal backwash procedure.

To overcome this condition the unit was placed on a 6-day regeneration cycle along with a thorough backwash every three days. Further checks indicated the need of even more frequent backwashing, so the unit was placed

on a 24-hr backwash schedule with a complete regeneration every sixth day. This schedule helped maintain satisfactory operation over a long period, but tests showed effluent hardness was slowly increasing and, after about 3½ months, it was difficult to maintain zero or near-zero hardness. A second check of the exchanger bed showed lime deposits, similar to mud balls found in filter units. The lime balls had formed slowly. Soon they became heavy enough to work their way to the bottom of the bed, making it impossible to backwash them out of the tank.

Acid Treatment. To clean the unit it was given an acid bath, backwashed, then regenerated in the normal manner. After being returned to service it performed satisfactorily. A definite schedule for acid treatment was not set up; its frequency was determined by effluent hardness—a function of the hot-process unit's efficiency. Lime precipitated in the free-board section of the softener, and so was not exchanged by the resin. It is evident that excess lime, which was precipitated or exchanged within the softener, would under former operating conditions pass into the service lines, pumps and boilers to cause scale. Only remedy was an excessive amount of chemical treatment.

Backwash Rate. One important fact to consider in the resin process is the increased backwash flow rate required when operating under high-temperature conditions. As temperature goes up water viscosity decreases; so flow rate must be increased, Fig. 1, to obtain desired expansion and proper cleaning of the resin bed. Preliminary work on this problem was conducted in the Illinois Water Treatment Co laboratory in 1945 at temperatures up to 150 F. Regeneration can be carried out either with hot-process effluent or cold raw water. But it was found best to use the former to eliminate frequent temperature shocks to the exchange material.

TABLE I: AVERAGE COMPOSITE WELL-WATER ANALYSIS

Ca	—	14.3 grains per gal as $CaCO_3$
Mg	—	10.1 grains per gal as $CaCO_3$
Na	—	0.7 grains per gal as $CaCO_3$
SiO_2	—	16.5 ppm as SiO_2
HCO_3	—	19.7 grains per gal as $CaCO_3$
Cl	—	1.1 grains per gal as $CaCO_3$
SO_4	—	4.3 grains per gal as $CaCO_3$
pH	—	7.7

Over-all Economics. In any process, improvement of end results is important, but the economics of the arrangement must warrant the initial equipment as well as maintenance and operating costs. Chemical savings obtained with Illco-Temp equipment were indicated theoretically, and confirmed in actual pilot-plant operations. But the life and efficiency of the exchange material could only be determined by tests under actual operating conditions over a prolonged period, Fig. 2.

Illco-Way C-211 polystyrene cation resin is extremely durable over a wide pH and temperature range, and has excellent physical properties, assuring long life and economical operation. Later laboratory studies revealed an increase in (1) salt efficiency and (2) total grains exchange, obtainable by using a higher salt concentration during brining. Although changes were not made in pilot-plant operation to take advantage of this information, it was incorporated in subsequent units.

Exchange Capacity. Average hardness of effluent from the lime-soda unit was found to be 1.4 gpg. Records show that the exchange material operated at an average exchange capacity of 24,000 grains per cu ft. Therefore, each cu ft will soften 17,143 gal of effluent. Using 15 lb NaCl per cu ft for regeneration and figuring NaCl at 0.75¢ a lb cost per 1000 gal treated amounts to 0.66¢. The pilot-plant unit had an over-all capacity of 136,000 gal between regenerations (one a week).

Each regeneration required about one man-hour at $1.75 an hr, plus 15 min a day for backwash costing 1.5¢ per 1000 gal, or a total operating cost of 2.1¢ per 1000 gal. Greatest portion of operating cost is due to direct labor. This can be reduced proportionately with larger units since they require no more attention, and have higher capacity between regenerations.

After several months' operation, pilot-

TABLE II: ANALYSIS OF WATER TO AND FROM THE RESINOUS-SOFTENER PILOT PLANT

	Water to resinous softener					Water from resinous softener			
Date	Gal per day	Hardness as $CaCO_3$, gpg	pH	P alkalinity	M alkalinity	Hardness as $CaCO_3$ gpg	pH	P alkalinity	M alkalinity
4-26-48	17,100	1.6	9.55	0.5	2.3	0	9.70	0.7	2.5
4-27-48	18,600	0.9	10.28	1.0	2.4	0	10.35	1.2	2.6
4-28-48	17,500	1.2	9.75	0.7	2.2	0	9.88	0.9	2.4
4-29-48	18,150	1.3	9.65	0.7	2.1	0	9.76	0.8	2.3
4-30-48	15,400	1.0	9.90	0.8	2.5	0	9.98	0.9	2.6
7-26-48	20,500	1.5	9.6	0.5	2.4	0.1	9.83	0.8	2.7
7-27-48	21,400	1.5	9.3	0.7	2.4	0	9.50	0.7	2.5
7-28-48	21,250	1.7	9.5	0.5	2.3	0	9.69	0.8	2.8
7-29-48	20,400	0.9	10.37	1.1	2.2	0	10.42	0.9	2.1
7-30-48	19,100	6.0	8.4	0.1	5.9	0	8.75	0.3	6.1
8-2-48	20,850	1.2	9.58	0.6	2.1	0	9.95	1.0	2.9
8-3-48	15,300	0.9	10.55	1.4	2.2	0	10.62	1.6	2.4
8-4-48	12,700	1.7	9.61	0.7	2.4	0.2	9.95	0.95	2.5
8-5-48	4,280		Unit regenerated						
8-5-48	17,800	0.8	10.23	0.9	1.9	0	10.43	1.1	2.0
8-6-48	17,300	1.1	9.55	0.5	2.1	0	9.71	0.7	2.1

Note I: M and P readings represented as gpg $CaCO_3$ equivalent.

Note II: Hardness determined using Nalco standard soap, 0.3 cc lather factor.

Operating Conditions:
Average temperature = 218 F
Average pressure = 35 psig

Unit dimensions:
8 cu ft cation exchanger
¾-in. hot-water meter
1¼-in multiport single control valve
24-in. reactor tank

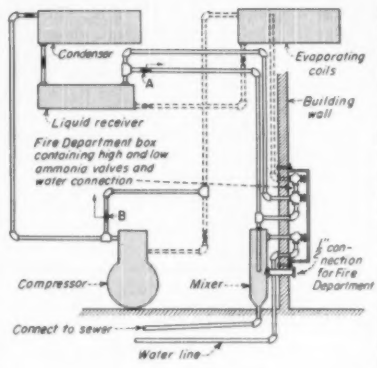
plant and boiler records showed the desired 40-ppm phosphate concentration could be maintained with a 60% reduction in phosphate post-treatment. Although chemical savings were significant, they were not the only advantages obtained. Before the pilot plant was installed the four boilers were regularly opened once a year for inspection and cleaning, which consisted of turbining the tubes and brushing down the drums. This operation required two men, three days per boiler, or a total of 24 man-days for the four boilers.

Regular boiler-cleaning period came after the pilot-plant softener had been in operation about nine months. The two boilers, which had been operated on after-softened feedwater from the resin exchanger, were found to contain a small amount of paper-thin scale on the bottom ends of the drums out of the path of normal circulation. Cleaning, which consisted simply of hosing the drums, was completed in 6 man-hours for the two boilers. This is contrasted to previous 12-man-day requirements for two units. Since the power plant must be available during the work week, cleaning had to be scheduled during the weekend. Reducing overtime pay is, in itself, a major item in plant cost.

New Equipment. In the spring of 1949, National Lock Co put a new Springfield 565-psi 750-F 110,000-lb-per-hr 2-drum boiler in operation. As pretreatment of the makeup water, a new 10,000-gph hot-process lime-soda softener was installed. Based on the results obtained during pilot-plant operation, a 10,000-gph Illco-Temp resinous softener was in-stalled for after-treatment of the lime-soda effluent boiler supply.

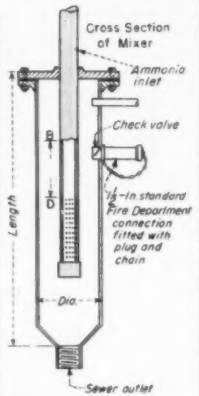
Although the reduction of chemical post-treatment obtained by using a resinous softener is of economic importance, it is only minor in comparison to other advantages derived from its use. Tabulated test data, Table II, show the softener is capable of leveling the irregularities of the hot-process softener operation, giving a water with a consistent residual hardness of zero by the standard B & B soap test. This allows a reduction in the amount of phosphate needed to maintain boiler-water concentrations, which in turn reduces the amount of blowdown required. Since after-precipitation is held to an absolute minimum, maintenance of feed lines and pumps is reduced and greater operating efficiencies are obtained by clean boiler equipment.

EMERGENCY DISPOSAL OF AMMONIA FROM REFRIGERATING SYSTEMS



Sizes of Equipment, Piping, Mixer and Valves

Rated Tonnage	Hp of Motor	Charge of Ammonia, Lb	Mixer								Hand Valves		Safety Valves	
			Dia, Inches	Length, Feet	Sewer Outlet	No. of 3/32 Holes	Ammonia Inlet	Water Inlet	No. of Holes	Dia. of Holes	Low Side	High Side	Conn. A (Recip. Comp.)	Conn. B (Comp.)
Upto 1/2	1	25	3	4	2	120	3/8	1 1/2	12	3/8	3/8	3/8	1/4	1/4
1	2	50	4	4	2	180	3/8	1 1/2	12	3/8	3/8	3/8	3/8	1/4
2	3	75	5	4	2	200	1/2	1 1/2	12	3/8	3/8	3/8	3/8	3/8
3	5	100	5	4	2	200	3/4	1 1/2	12	1/2	1/2	1/2	3/8	3/8
5	7 1/2	200	5	4	2	240	3/4	1 1/2	12	1/2	1/2	1/2	1/2	3/8
10	15	300	5	5	2 1/2	280	1	1 1/2	18	3/4	3/4	1/2	1/2	1/2
15	25	450	5	5	2 1/2	280	1	1 1/2	18	3/4	3/4	1/2	1/2	1/2
25	40	600	6	5	2 1/2	300	1 1/4	1 1/2	18	1	1	3/4	1/2	1/2
30	50	750	6	5	2 1/2	360	1 1/4	1 1/2	18	1	1	3/4	1/2	1/2
50	75	1200	6	6	3	420	1 1/4	2	20	1	1	3/4	3/4	3/4
75	125	1600	7	6	3	540	1 1/2	2	20	1 1/4	1 1/4	1	3/4	3/4
100	150	2000	7	6	3	620	1 1/2	2	20	1 1/4	1 1/4	1	1	1
150	250	3000	8	6	3	900	2	2	20	1 1/4	1 1/4	1 1/4	1	1
200	300	3500	8	6	3	1000	2	2	20	1 1/2	1 1/2	1 1/4	1 1/4	1 1/4
300	450	5000	10	6	4	1400	2 1/2	2	24	2	2	2	2	2
600	900	10000	14	6	4	2500	3	3	24	2	2	3	2 1/2	



Courtesy of Division of Fire Prevention and Investigation, San Francisco, California

DISPOSAL MIXER is a simple device easily made in the plant shop from cross-section view at right. Place unit near outer wall so the shutoff valves can be operated from outside. Use table to find the mixer capacity, and size and pipe needs

Disposal Unit Gets Rid of Ammonia in a Hurry

► ESCAPING AMMONIA can hamper rescue squads and firemen just when it is imperative that they get inside a building to remove the injured or fight a fire. Also, during an emergency there never seem to be enough gas masks to go around. And the type of mask usually available is useless unless the area in question contains enough oxygen to support life.

Taking all factors together, the setup would be perfect for a serious accident except for one practice: Engineers know how dangerous ammonia can be, and so keep piping, pressure vessels and other containers in first-class condition to ward off accidents.

As a further safety precaution: Sketch above shows how to construct and install a dispo-al unit to dump ammonia to the sewer if a serious leak or fire develops. The device itself is simple and easy to make, greatest cost is the piping from different points to the mixer. When planning the layout put all shutoff valves at the mixer, because a closed valve at the vessel to be dumped destroys all value of the disposer during an emergency when fast action is demanded. *But before going to the expense of installing such a system consult local authorities about dumping ammonia to the sewer.*

TRANSIL-OIL FIRE. Two men handle the 2½-in. high-velocity fog nozzle used in putting out transil-oil fire in the 17-ft-diameter pit. The curtain of fog between the fire fighters and the flames gives protection to the men from the intense heat

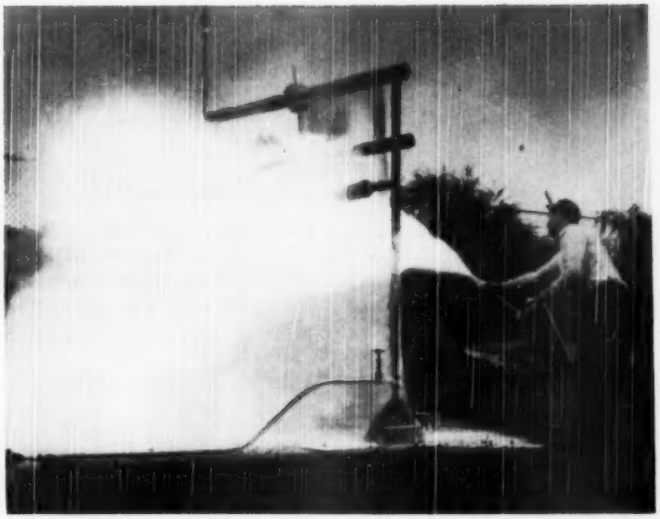
Utility Trains Fire Fighters

Over 1200 men learn how to put out fire with dry chemicals and water fog—also, when to let a fire burn out

By W E ROSSNAGEL
Safety Engineer
Consolidated Edison Co of New York

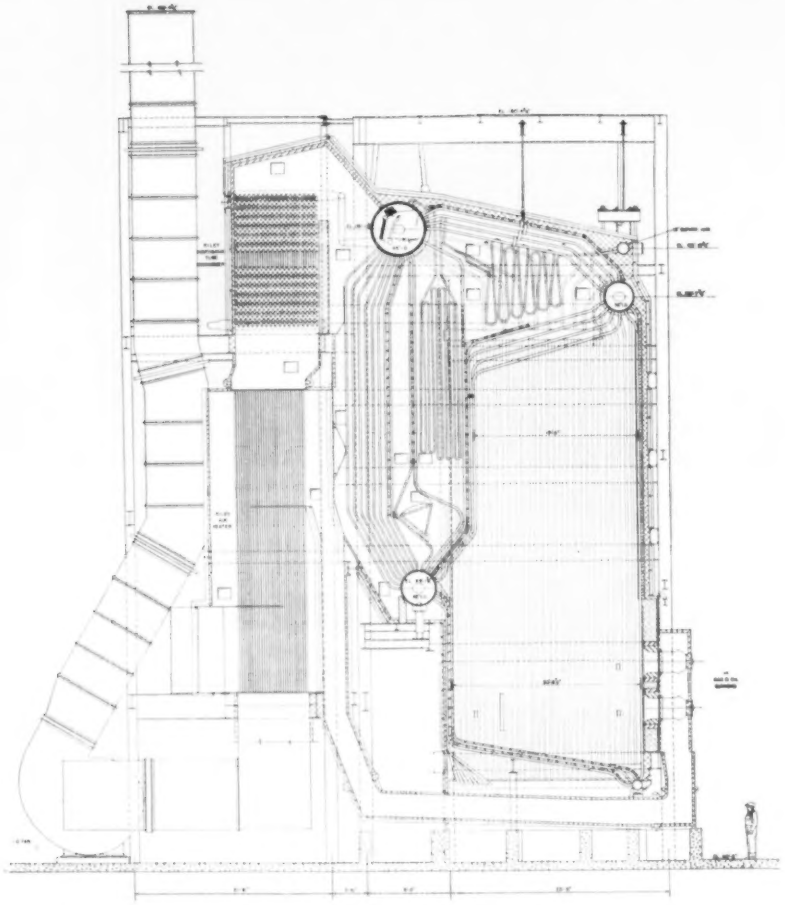
► FOR THE THIRD CONSECUTIVE YEAR the Consolidated Edison Co of New York has conducted a fire school at its Astoria gas works. This school trains key personnel in (1) what causes fires (2) when they should be extinguished (3) when it's best to let them burn out (4) proper technique for extinguishing them (5) behavior of inflammable vapors.

Fire Equipment. The fire-school grounds cover a 125x300-ft area with oil pits ranging in size from 3 to 17 ft in diameter. Equipment includes a paint locker, an auto truck, a trough for running oil fires, a street manhole with



DRY CHEMICALS are used to extinguish a propane fire at a defective gasket in a 4-in. pipe flange under 125-psi pressure when the shutoff valve cannot be reached

Two Recent Riley Public Utility



HOUSTON LIGHTING & POWER CO.—West Junction Station—Houston, Texas
2-850,000 lbs./hr. 1050 lbs. Pressure 905° F. Temperature
Gas and Oil Fired Riley Steam Generating Units
Ebasco Services, Inc., Engineers

TRADE MARK Rx REGISTERED

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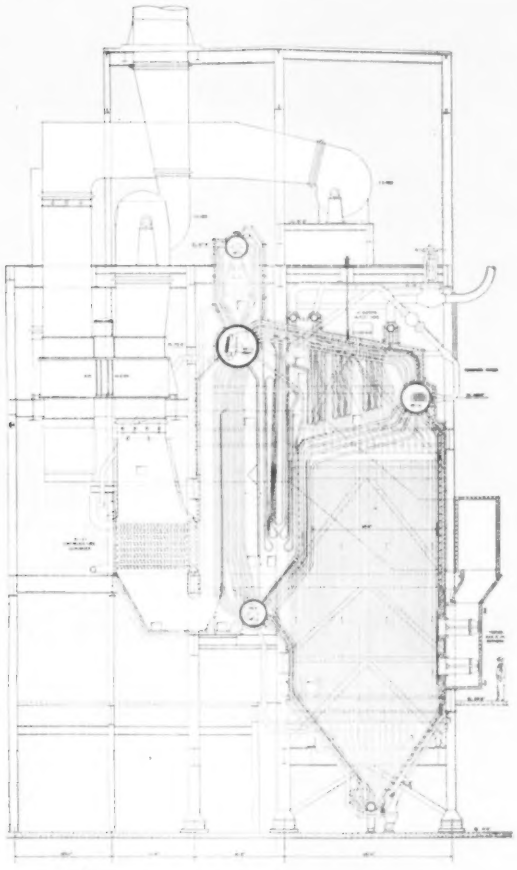
Boiler Installations

A Few of the many Riley Public Utility Installations



HARBOR STEAM PLANT, Los Angeles Dept. of Water & Power
3-825,000 lbs./hr. 1200 lbs. Pressure 900°F. Temperature
Gas and Oil Fired Riley Steam Generating Units

Houston Lighting & Power Co.
West Junction Station — 2-850,000 lbs. hr. units
West Junction Station — 2-400,000 lbs. hr. units
Greens Bayou Station — 2-675,000 lbs. hr. units
Gable Street Station — 1-350,000 lbs. hr. unit
Gable Street Station — 1-250,000 lbs. hr. unit
Gable Street Station — 1-140,000 lbs. hr. unit

Public Service Co. of Indiana
Dresser Station — 1-300,000 lbs. hr. unit
Edwardsport Station — 3-400,000 lbs. hr. units
Noblesville Station — 3-300,000 lbs. hr. units

Utah Power & Light Company
Orem Station — 1-450,000 lbs. hr. unit
Jordan Station — 1-620,000 lbs. hr. unit

Arkansas Power & Light Co.
Cecil Lynch Station — 1-650,000 lbs. hr. unit

City of Los Angeles
Harbor Steam Station — 3-825,000 lbs. hr. units
Harbor Steam Station — 2-675,000 lbs. hr. units

Central Illinois Light Co.
R. S. Wallace Station — 1-600,000 lbs. hr. unit
R. S. Wallace Station — 1-375,000 lbs. hr. unit
R. S. Wallace Station — 2-300,000 lbs. hr. units

Southwestern Public Service Co.
Berger, Texas — 1-330,000 lbs. hr. unit

Carolina Power & Light Co.
Moncure Station — 2-330,000 lbs. hr. units

Worcester County Electric Co.
Webster Street Station — 1-325,000 lbs. hr. unit

New Orleans Public Service Co.
Market Street Station — 1-330,000 lbs. hr. unit

Pennsylvania Electric Co.
Williamsport Station — 1-300,000 lbs. hr. unit

Iowa Illinois Gas & Electric Co.
Riverside Station — 3-250,000 lbs. hr. units
Coralville Station — 1-60,000 lbs. hr. unit

South Carolina Power Co.
Hagood Station — 1-310,000 lbs. hr. unit
Hagood Station — 2-230,000 lbs. hr. units

Mississippi Power Co.
Plant Eaton — 3-230,000 lbs. hr. units

Gulf Power Company
Pensacola, Fla. — 2-230,000 lbs. hr. units

West Penn Power Co.
Milesburg Station — 2-210,000 lbs. hr. units

Ohio Edison Company
Mad River Station — 1-250,000 lbs. hr. unit
Akron Heating Station — 2-90,000 lbs. hr. units

Interstate Power Co.
Lansing Station — 2-120,000 lbs. hr. units
Fox Lake Station — 2-120,000 lbs. hr. units
Clinton Station — 1-45,000 lbs. hr. unit

Central Ohio Light & Power Co.
Woodcock Station — 2-120,000 lbs. hr. units
Woodcock Station — 1-90,000 lbs. hr. unit
Woodcock Station — 2-60,000 lbs. hr. units

Northern Virginia Power Co.
Riverton Station — 1-350,000 lbs. hr. unit

Otter Tail Power Co.
Hoot Lake Station — 1-160,000 lbs. hr. unit
Cookston Station — 2-75,000 lbs. hr. units
Wahpeton Station — 2-100,000 lbs. hr. units
Devils Lake Station — 1-75,000 lbs. hr. unit

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

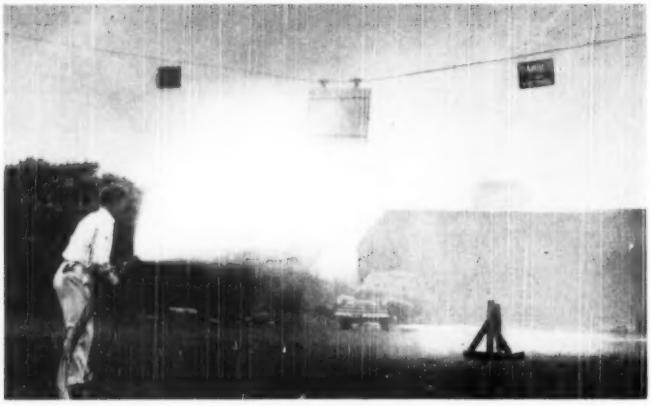
. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS · WATER-COOLED FURNACES · STEEL-CLAD INSULATED SETTINGS · AIR HEATERS

UTILITY'S FIRE SCHOOL

CONTINUED

OIL FIRES CONFINED. Low-velocity fog tip on the end of a 12-ft pipe handled by four men can be used on oil fires in confined locations and in places not easy to get at. This fog is also effective on fires in low-flashpoint oils provided they are not larger than 8 to 10 ft in diameter. Shown is the low-velocity fog nozzle being used on a transil-oil fire in the 17-ft-dia pit



WATER FOG (center) shows that it can, if necessary, be safely used on live electrical apparatus. The instructor holds the 2½-in. brass nozzle in his bare hands and, from a distance of six feet, directs the fog onto a target energized at 27,000 v. River water, salt, is used. Cable attached to the nozzle goes to an electrical instrument, and is not a ground wire

HIGH TENSION. In addition to CO_2 and water fog from wheeled extinguishers, on high-tension electrical fires, the use of carbon tetrachloride is demonstrated

three transformers in it, a 75-kva oil-cooled transformer, an elevated tank, overhead piping with a defective gasket in a 4-in. pipe flange from which oil or propane escapes under pressure, a 15x30-ft building used as a high-tension electrical compartment in which are three transformers. Other equipment are a large tank for experimenting with surface foam, and an overhead line with a grating target suspended from it and energized at 27,000 v to ground.

A building, commonly known as the "smoke house," has a frame construction with wire lathe and fire-resistant plaster on the inside surfaces. This construction was adopted to get first-hand data on how effectively this plaster resists fire. Even though about 200 severe fires have been produced inside the building, plaster has no cracks.

Who Attends School? Over 1200 men have attended the 3-hour sessions at the school. They include, in addition to company employes, staff officers of the New York fire and police departments, police emergency-squad officers of fire departments of nearby cities and towns, representatives of public and utility companies from eight states and from Brazil, a representative of the government of India, insurance company inspectors and representatives of the Port of New York Authority, and a number of fire-protective-equipment manufacturers. President of the Consolidated Edison Co. his assistant, three company vice-presidents attended the school.

1950 . . .
Our Industrial Machine Is Running Down

In his recent Economic Report to Congress President Truman chalked up a constructive advance in his economic reasoning. He pointed out that if we are going to attain the worth-while goal of a $300 billion national income in the next five years, we must equip ourselves with more and better industrial tools. Of all the dynamic forces of expansion in America, he said, one of the most important is business investment.

That is fine. It is basic common sense. We have been saying that for years and we are glad to hear the President say it too.

But having hit this new high in his economic reasoning, the President failed to draw the right conclusion. He made the mistake of accepting the false conclusion that there is no shortage of business funds to pay for more and better industrial tools. "There are immense opportunities for business investment in nearly every segment of the economy," the President said, and further, "there are in general sufficient funds available to businessmen who want to seize these opportunities."

That just is not so – and the lack is not only serious; it can well be fatal.

It is a matter of the most urgent national importance that the President's recognition of the need of more and better industrial tools should be followed by effective action. *That calls for changes in the national policies that are now blocking and, unless changed, will increasingly block business from meeting this need. If business cannot get enough new tools, the result will not be higher, but lower standards of living five years from now.*

The President should talk this matter of business investment over with Senator O'Mahoney, the Chairman of the Joint Congressional Committee on the Economic Report. Senator O'Mahoney would take to the discussion knowledge of the investment situation recently acquired through his conduct of a series of Congressional hearings.

If he told the President what he told the press during the course of these hearings, he would say, "the private capitalistic system is being seriously threatened by a lack of venture capital." That is in direct conflict with the President's conclusion that "there are in general sufficient funds available."

This serious shortage of adequate investment in new plant and equipment is brought forth so that all of us can understand it by McGraw-Hill's annual survey of American industry's plans for investment in new plant and equipment in 1950, which has just been completed.

continued on next page

BUSINESS' PLANS FOR 1950

These are the major findings of the McGraw-Hill survey of "Business' Plans for New Plants and Equipment" in 1950. Made by the McGraw-Hill Department of Economics, the survey shows:

1. Industry—as represented by manufacturing, mining, transportation, and utilities—now plans to invest $12.4 billion in new plants and equipment this year. This is 13% less than was actually spent last year.

2. Manufacturing industries alone plan to spend $6.3 billion in 1950 for new facilities. This is also 13% less than they spent last year.

3. Manufacturers as a whole expect their 1950 sales volume to about equal 1949's.

4. Manufacturers will expand their capacity about 3% in 1950, under present plans. The largest part of their funds, 65%, will go to replace and modernize existing facilities.

5. Profits and reserves are expected to provide 92% of the 1950 investment funds of manufacturing companies. These companies count on new common stock issues to provide less than one-half of one per cent of the investment funds they will need.

6. Two out of three manufacturing companies review their investment plans monthly. Almost all companies go over them at least quarterly. The survey shows that companies changed plans rapidly during 1949 to meet changes in their prospects.

7. Other industries are also reducing their investment plans in 1950 by 13%. This coincidence arises from the fact that utility companies, notably the electric light and power companies, plan to spend only slightly less than in 1949. Railroads, on the other hand, are reducing their capital programs in 1950 by more than 40%.

A copy of a complete report on "Business' Plans for New Plants and Equipment" may be obtained by writing me at McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York 18, N. Y.

The results of the survey, which are summarized above, show that American Industry—as represented by manufacturing, mining, transportation and utilities—is planning to spend 13 per cent less for new plant and equipment in 1950 than it did in 1949.

Since the rate of investment in new plant and equipment right now is apparently about 15 per cent below the rate for 1949, the present level of business investment may be relatively steady in 1950. That would relieve the fear, expressed by President Truman in his Economic Report, that "if the downward trend in business investment were to continue, our prospects for full recovery and continued expansion would be seriously endangered."

BUT, at the rate of investment planned by American manufacturing industry for 1950, it would take 40 years to modernize thoroughly our present industrial plant and equipment. That would still leave undone the job of increasing it to meet the needs of an expanding economy of the kind sketched by President Truman in his message.

In attaining even this rate of investment, the McGraw-Hill survey shows American business must rely overwhelmingly on its own profits, which have declined as the country has left the postwar boom behind it. Most American companies cannot sell new common stock except at ruinously low prices. Here is one case where government action is really needed to help business and help to keep a rising American standard of living.

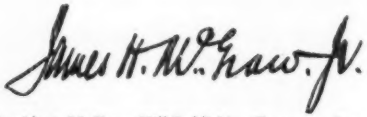
In order to get enough business investment to assure the "full recovery and continued expansion" sought by the President, our country needs:

1. Lower taxes on business income so as to release more money for new plant and equipment.

2. Liberalized depreciation allowances on old plant and tools so that business can buy new equipment faster.

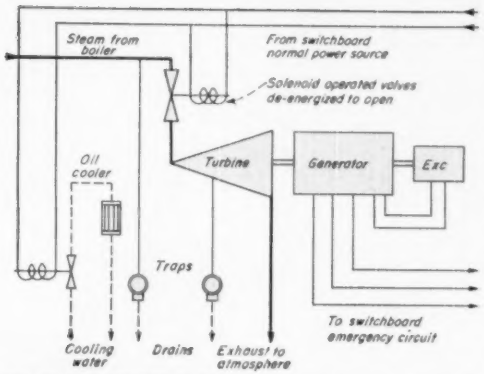
3. Repeal of the present double taxation of dividends which now are taxed once as corporation income and again as personal income.

It is encouraging to have the President explicitly recognize the key importance of adequate business investment in providing steadily expanding prosperity. The next and most important thing to do is to make this recognition effective by discarding national policies which are blighting an adequate volume of business investment.



President, McGraw-Hill Publishing Company, Inc.

By E W BURSTADT and J L MANGAN, *Turbine Divisions, General Electric Co*



EMERGENCY STANDBY SETS must have automatic starting arrangements for maximum usefulness, and be tested periodically

STEAM TURBINES DRIVE EMERGENCY STANDBY GENERATORS

Dear Mr Specialist:

The superintendent here, at the hospital, has asked me to make a survey of emergency power. This supply will run our elevators, operating-room equipment, emergency lighting and electric-driven boiler auxiliaries should outside power fail.

I have been thinking we might use a small steam turbine driving a 60-kw 3-phase 60-cycle 480-v generator, but am not sure you would recommend this application. Has it ever been used? Do you think it would be a good idea?

I think we will have plenty of 100-psig dry steam available for such a turbine, but would like to know how much it will take.

Yours very truly,
ENGINEER

Dear Mr Engineer,

Equipment for generating emergency power is like casualty insurance. You hope never to use it, but when you do need it, it should come through quickly and dependably. Wherever steam is available, a turbine-driven generator set is a good choice for this service because:

1. Turbines provide a reliable source of power.
2. Turbines can be started automatically and quickly on loss of main power.
3. Turbines compare favorably in first cost with engine sets in all but the smallest ratings.
4. Turbines require minimum maintenance during both standby and operating periods.
5. Turbines need little floor space and can be set in an out-of-the-way corner.

Emergency turbine-generator sets have performed faithfully when called on in oil refineries, chemical plants and other industrials as well as in hospitals. A good example of such service in a hospital occurred when the hurricane of 1938 struck the northeastern states. An emergency set had been installed in a large New York hospital less than a week before the blow. When outside power was lost the set started immediately and supplied power until outside lines were repaired several days later.

Sketch, left, shows the hookup for a turbine-generator set for emergency service. It consists of a single-stage mechanical-drive turbine connected directly to a generator through a flexible coupling. A solenoid-operated valve admits steam to the unit immediately on loss of main electrical power. In less than 10 sec the unit comes up to governed speed ready for loading. Another solenoid controls cooling-water flow to the oil cooler. With the steam line properly trapped and a trap in the turbine-casing drain line, the unit is always ready to operate. A unit, running on dry steam at 100 psig and exhausting to atmosphere at about 5 psig, needs about 6000 to 7500 lb per hr of steam, depending on wheel size of the turbine needed.

Though normally idle, an emergency set must always be ready to start. The amount of attention needed to keep it in constant readiness can have an appreciable effect on operating expense. A turbine set should need turning over about once a month during standby periods. Other prime movers adaptable to emergency generating service usually require operation at more frequent intervals to maintain the equipment and assure constant readiness. Parts of a turbine that are vulnerable to corrosion during idleness are easily protected. Valve stems and bushings, exposed springs and governor wearing parts are made of corrosion-resistant materials. Monel metal, sprayed on the turbine shaft under the packing fits, prevents pitting at this important point. These features together with a properly trapped and drained piping system will safeguard the turbine from corrosion, normally one of the worst enemies of idle equipment.

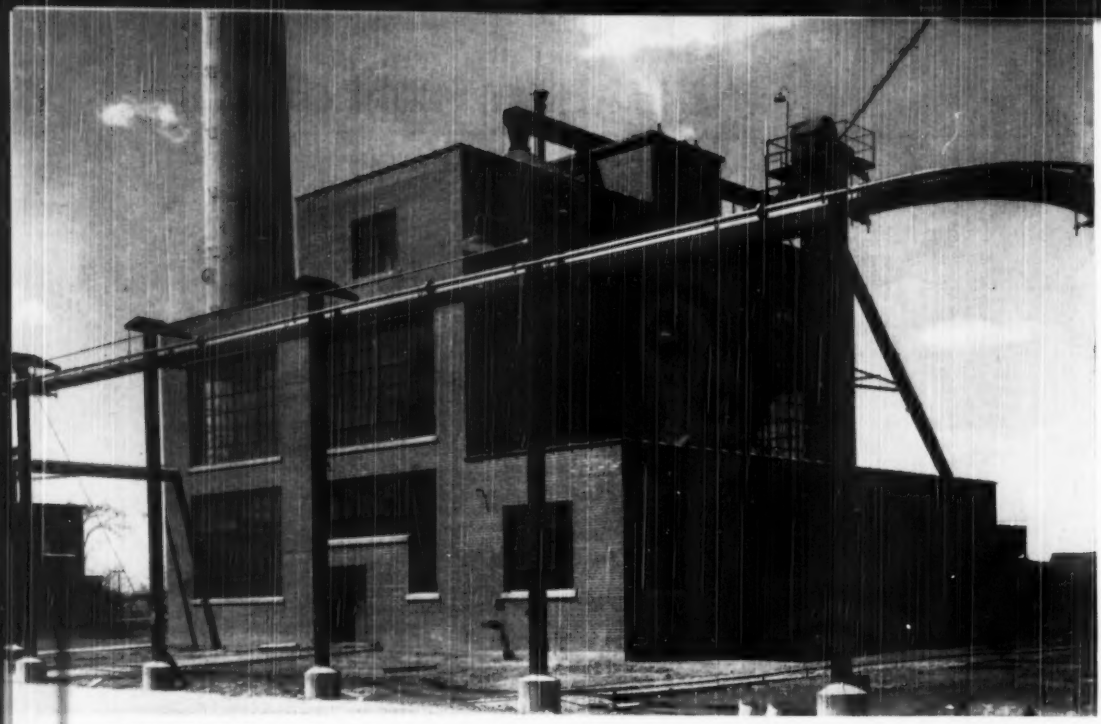
Work and confusion resulting from an emergency keeps operating personnel well occupied. At such times dependable, troublefree service of a turbine set is appreciated.

Because it needs minimum attention the turbine set can be installed in an out-of-the-way corner without making inroads on time (and tempers) of operating personnel. It will be a compact unit needing less than 4x8 ft of floor space. It weighs about 2 tons. No separate fuel system with its attendant safety and supply problem is required. Turbines, quiet in operation, need no mufflers or soundproofing to eliminate objectionable noise.

Based on consideration of quick automatic starting and dependable operation, low first cost, minimum upkeep and ease of installation, turbine-generator sets are the logical choice for standby power where steam is available.

I would appreciate an opportunity to discuss your application at your convenience. After studying your system, I am sure we can recommend a unit that will give you dependable and economical protection against power failures.

Sincerely yours,
TURBINE SPECIALIST



INDUSTRIAL STEAM PLANTS like this typical modern installation can have the same reliability and efficiency in coal handling as big central stations if design is geared to take the tough conditions that may develop in course of operation

How Coal Handling in Small Plants Can

A system that is tops most of the time may falter when weather gets bad and coal is dirty. E H Roper, consulting engineer of Toledo, draws on experience to show practical ways of curing troubles and of avoiding them

► WHEN THE WEATHER turns wet or freezing, and coal comes in loaded with real estate as well as Btu's, even the best-behaved coal-handling systems may give operators just cause for plain and fancy cussing. How to cope with clogging and sticking? In an existing plant, some changes may be in order. For a new plant, the best bet lies in designing to avoid future trouble. Let's look at some cases to see what happens and what can be done about it.

Examples and recommendations that follow grow out of experience with coal-handling systems for 50 tph, or less. In these relatively small plants, spreader stokers formed the usual firing equipment. As a starter, consider how changed conditions affected coal handling in one plant.

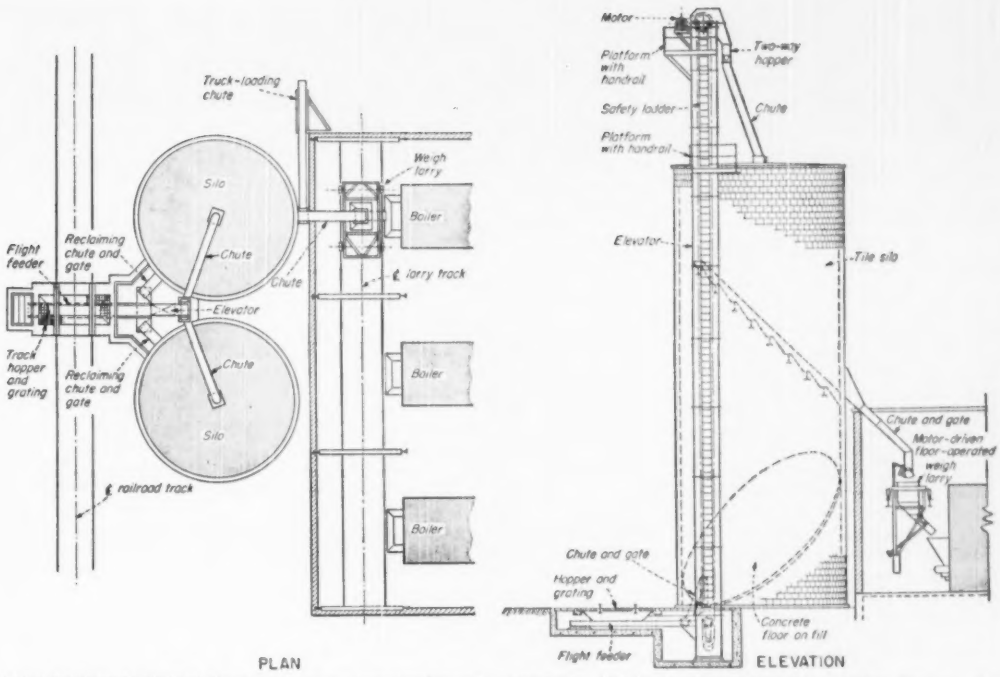
One Case. We designed this plant to burn coal from a certain mine. The coal might have been called a poor grade, but it burned well on spreader stokers. On a therm basis it was most economical. It was being handled in another plant by flight feeder, bucket conveyor and steel bunker. The plant we designed used the same equipment except that a silo with a live shelf, and a larry, replaced the steel bunker. Coal-handling installation layout appears at top of the facing page.

Trouble began with wet weather. Buckets clogged and filled, elevator capacity fell off 75%. Chutes plugged at the bifurcated (pair-of-pants) connection between elevator and silos. Stoker feeders ran into difficulties.

We'll take up remedies attempted and results obtained later. Let's first take a look at the coal. It was 1½x0-in., with about 50% through a ¼-in. circular-mesh screen. It contained approximately 3.8% sulfur, which would leach out and form horizontal layers ½- to ¾-in. thick in the outdoor-storage pile. Ash content ran 18%, about two-thirds of it being white fire clay.

A 2-qt Mason jar filled with coal to about 2 in. of the top and then completely filled with water, capped and shaken, would show ½ in. of mud on top of the coal after settling overnight. Incidentally, this is a good test for dirty coal.

What Changed? Now why was it that the first plant had no trouble with this coal while the new one had so much? A checkup showed that while the new plant was being built, the producer started mining from a new seam. The old one had



COAL-HANDLING SYSTEM sketched above ran into clogging and sticking troubles in bad weather, after coal quality changed drastically. Unit-heater installation shown below was one of the modifications to the layout that cleared up difficulties

Beat Tough Going

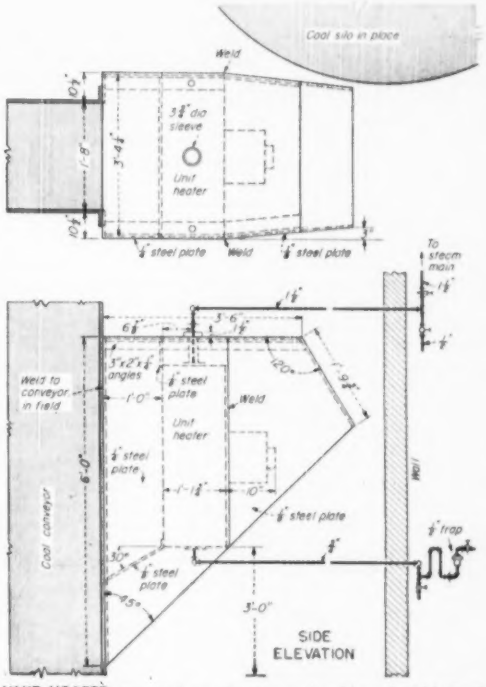
been exhausted. At the same time, mechanized loading was begun. The new seam had a clay floor and, since the mine was small, washing equipment wasn't practical. There was the answer to the troubles. The first plant got out from under by changing source of coal when trouble first appeared.

If the newly built plant had been smaller, it might have been a good idea to follow the example of the first plant and swing over to washed coal. In this case, however, the coal was burned without trouble and the conveying equipment behaved well during about eight months of the year.

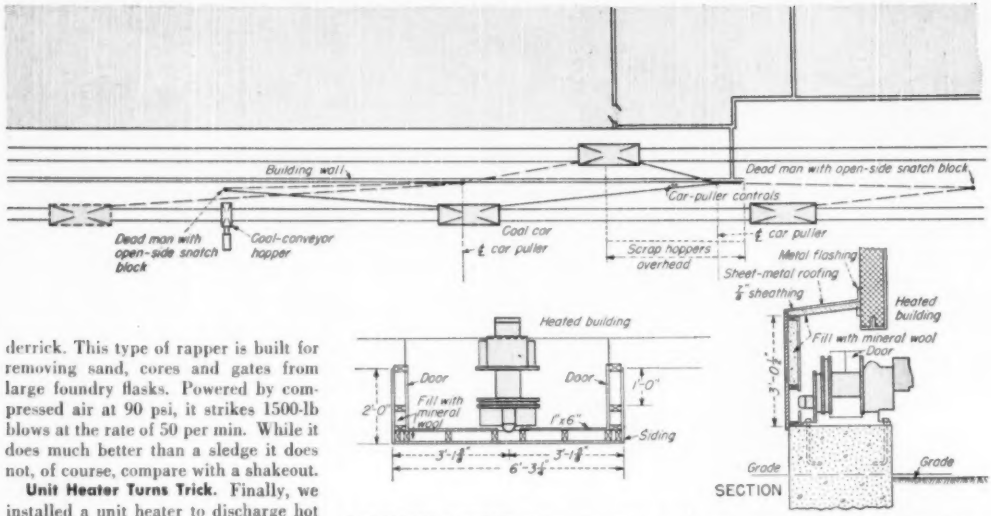
Car-thawing Pit. When the plant was built a car-thawing pit was installed. In cold weather cars arrived with pockets frozen solid. Fifteen minutes' operation of the thawing pit, per pocket, would free the most obstinate car. Water would pour from the cars almost as if a fire hose were playing on the coal.

The pit was about 24 in. deep and 24 in. wide in cross section, with an open top beneath the rails. It was refractory lined. A gas burner under each rail fired toward the center of the track, producing an intense radiant flame. We have also built oil-fired pits, which proved entirely satisfactory.

Improvised Rapper. But how to get coal to flow from the cars? It would stand vertically, and constant poking proved necessary. A shakeout was the obvious answer but we decided to try less expensive means first. We bought a 5-in. flask rapper and attached it to an H column. The whole device was suspended against the side of the car by a winch-and-post



UNIT HEATER mounted on elevator casing blows hot blast of warming and drying air up casing and down chutes to the silos



CAR-PULLER LAYOUT shows two hoists with horizontal capstans for moving and braking cars from one control point. Plan and section show hoist installation details

derrick. This type of rapper is built for removing sand, cores and gates from large foundry flasks. Powered by compressed air at 90 psi, it strikes 1500-lb blows at the rate of 50 per min. While it does much better than a sledge it does not, of course, compare with a shakeout.

Unit Heater Turns Trick. Finally, we installed a unit heater to discharge hot air into the elevator casing about 8 ft above the foot shaft. The heater is a high-outlet-temperature high-velocity type, rated at about 750,000 Btu per hr. The propeller fan is motor driven. Drawing on preceding page shows layout.

Operator started the heater when he put the elevator into operation. Elevator and heater were left running a half hour or so after all coal was unloaded. This kept buckets from freezing until vibration of elevator running idle had a chance to loosen the accumulation. Warm air rose up elevator casing and down the discharge chute into the silo. Leaving manhole on silo top open permitted circulation.

Spontaneous Combustion. Heating of coal in both silos also gave trouble. One silo has no live shelf and is intended only for reserve storage. By the time heating was found, the coal had coked and couldn't be removed through the chutes at the silo bottom. Some improvement came from making openings in the silos near the bottom as airtight as possible. Recirculation of coal, however, was the real answer.

To detect heating in time to recirculate, we made an indicating thermocouple installation. At four locations per silo, thermocouples were suspended from spanning angle irons. Pushing proper buttons showed operator temperature in center of silos.

The blast of hot air into the elevator casing helped at the chutes also. Greatest relief, however, came from making the bottom two inches of the square chutes of stainless steel. The builder of the coal-handling equipment developed a 2-way hopper having a swinging section for diverting coal into one chute or the other. This was another step in the right direction. It eliminated pockets in which fine, sticky particles collected.

Stoker Feeders. While the stokers burned the coal well, they needed constant attention to keep the hoppers flowing. After we tried a number of expedients, the stoker builder designed a new feeder, a hopper with a larger bottom opening and with only one sloping hopper side. This cleared difficulties.

Points to Remember. These experiences point up a number of worthwhile lessons. They show, for example, what happens when conditions under which a coal-handling system must operate change unexpectedly for the worse. They also bring out the fact that spreader stokers are bringing into commercial application a range of coals of generally lower quality than was formerly common. This imposes tougher conditions on coal-handling equipment.

In my opinion, the designer of coal-handling systems of less than 50 tph should carefully consider the following:

Track Hoppers. These should be large enough to accommodate a full car of coal. Bottom should be steel plate, with valleys sloping at 5 deg or more. Four inches square is a good size for grating openings. Make construction heavy enough so tractor can drive over gratings.

Jarring of a skip hoist taking coal from the hopper will help coal to fall to skip-hoist gate. With a big enough hopper, a car can be discharged in a few minutes with a shakeout and, while the car is being moved, the skip hoist can unload the hopper.

Skip Hoists. For bad weather and coal conditions the skip hoist makes a good conveyor. It should be the automatic counterweighted type, large enough to avoid excessive speeds. A self-closing lid at the silo top, operated by the skip, proves a good feature. A little thought to access facilities and means for lubrication will help in maintenance.

Bunkers, Silos. With a continuous bunker over the firing aisle, and no under-bunker conveyor, coal may accumulate over unused stokers. This may lead to heating and the necessity of moving the coal. Use of such a long, narrow bin usually involves an additional piece of conveying equipment.

For the small plant, silos offer many advantages. They may be tile, steel plate or concrete, preferably with a conical bottom in the center of the silo from the weigh larry. For at least part of the bottom, steel is preferred. Interlocking the gate with the weigh larry prevents accidental discharge of coal to the boiler-room floor. If needed, a vibrator may be mounted on the steel-plate bottom. This should be operated only when coal is being discharged; otherwise, it will do harm, not good.

In this type of silo, the first coal put in storage is the first discharged to the weigh larry. This helps avoid spontaneous combustion. It is a good idea, however, to provide chute for discharging coal to a pile outside. A bindicator

If this copy of POWER reaches you late, it results from train cancellations caused by the coal strike. We regret this impairment of service, which is, of course, beyond our control.

is, of course, needed for stopping the skip hoist to prevent overflowing. One or two more at different levels in the bin save steps. If the skip hoist discharges into center of silo, and if silo is not more than 20 ft in diameter, segregation is unlikely to be troublesome even with coarse coal. Even so, a weigh larry gives some mixing.

Weigh Larry. When a weigh larry is installed it mounts on an overhead track over the firing aisle. A wound-rotor motor usually propels it. Square chute to stoker hopper should have its gate at the discharge end. Make capacity of larry such that operators are not too busy keeping stoker hoppers filled. Large hoppers for the stokers are a necessity. Don't use bare trolley wire for 440 v—use some form of trolley duct.

Handling Capacity. Conveying plant should have capacity enough to unload in four hours all coal burned in any 48-hr period. Silo storage should provide for 8-hr consumption at peak demand. If track hopper will hold a car of coal, this represents additional reserve. Ground storage can be provided by chuting from the silo to a pile for distribution and reclaiming by bulldozer. It's a good idea to pave the storage yard. No stoker should be expected to handle masses of clay picked up in ground storage.

Car Pullers. Car-thawing pits, shake-outs and car pullers prove a help and, in many cases, a necessity. Drawing on facing page shows a scheme that permits moving or braking cars with control from one spot. It was used for moving coal cars, spotting cars on a siding inside the building, and for moving cars beneath an overhead storage bin for scrap-steel turnings.

These car pullers are powered with an air motor and equipped with horizontal capstans. Wire rope, permanently attached to the capstans, may be wound out of the way when not needed. Cars may be inched or hoist stalled without damage. Since a rope is attached to each end of a car from one of the hoists, it is always possible to brake the car. In cold climates, car pullers should be installed in a heated enclosure.

Another layout makes use of an incline in the track on which the hopper is located. Grade is about 1.5 ft per 100 ft. The car puller hauls cars up the incline or acts as a brake when cars are allowed to coast down over the hopper. Unless track can be elevated without much additional cost, a second hoist usually proves more economical and convenient.

Coal Crushers. In many installations, a coal crusher pays dividends by permitting use of run-of-mine or over-size coal where properly sized coal commands a premium price. It is better to install a crusher than to try to feed 2-in. nut-and-slack to a spreader stoker. And if frozen coal must be handled, a crusher will save the day. Its use usually requires a scraper conveyor feeder.

Summing Up. Always bear in mind that a coal-handling system may have to cope with bad weather and dirty coal. Take these factors into account in planning and operation.

What to Do When a Tube Lets Go—Another Slant

By R H FREYBERG

Production Engineer, Waterside Station
Consolidated Edison Co of N. Y.

► OLDTIMER J M GORRIE'S ARTICLE, "There's a Tube Let Go in Number . . ." (Oct, pp 109, 110) should stimulate considerable discussion, particularly among operators of the newer high-pressure pulverized-fuel boilers. When a 1200- or 1500-psi boiler tube lets go, no one hunts for an inspection door to get a "fair view of the tube rupture." We keep a respectful distance from all boiler doors, for a furnace-tube rupture is an explosive affair. It douses the fire and so completely fills the furnace with steam that you can't go near the boiler for some minutes.

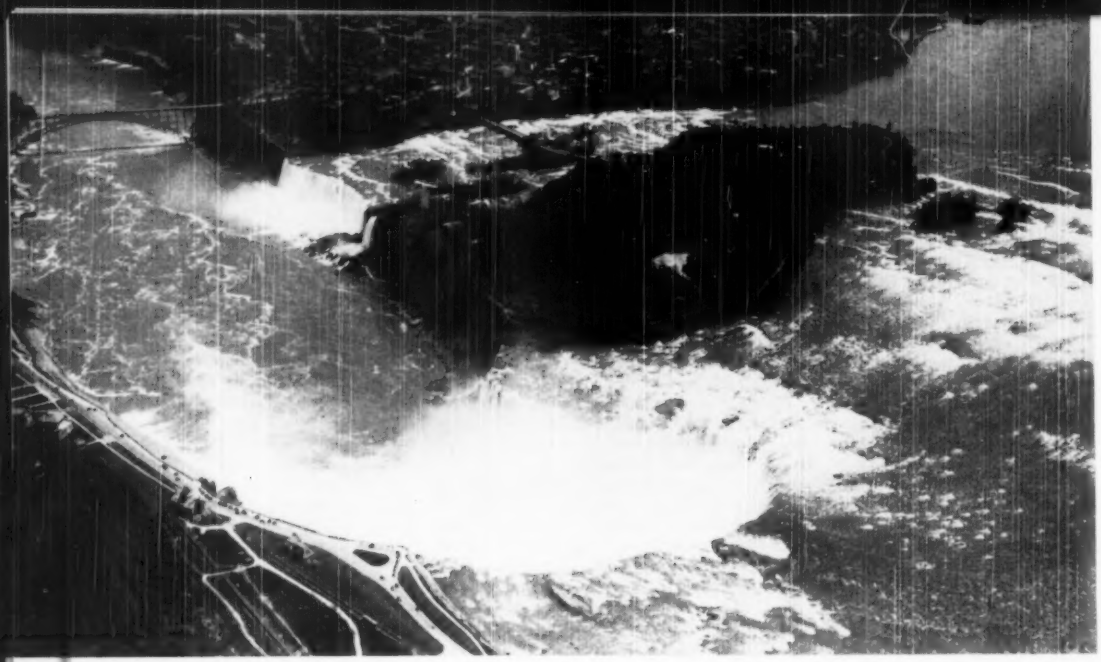
Standard instructions for forced shutdown of our 500,000-lb-per-hr and 680,000-lb-per-hr slag-tap units follow suggestions of one of the manufacturers. Primary concern is protection of the 54- and 60-in. boiler drums, which are 4½ to 6 in. thick. Under such conditions as tube rupture, the drum is empty of water although still under steam pressure. Should this metal be subjected to quenching action of relatively cold feedwater, extreme stresses would be set up, probably more seriously damaging to the unit than any that may accompany our procedure. Thus, if a tube failure requires immediate removal of the boiler from service, we follow the steps outlined in the box above.

Gorrie's procedure is not unlike ours, except for the feedwater question. We hold the opinion that by the time water level drops to the point where tubes are dry, there will not be enough heat from slag or refractory to do any damage to pressure parts. Use of this procedure with a number of tube failures over the past several years (on eight boilers) seems to bear us out.

Time to return unit to service also runs longer. With favorable tube location, we have cut out a 6- to 8-ft tube section and welded in a new one in about 24 hr. All things considered, this stacks up well with Gorrie's 10-11 hr.

Here's How One Plant Shuts Down After a Tube Failure

1. We first stop the coal feeders and mills and close the primary-air dampers
2. Then we close vanes on forced-draft fans. We also close-in vanes on induced-draft fans to minimum consistent with preventing steam and water entering the boiler room
3. Steam output from boiler must be stopped. If nonreturn valve does not operate, we close the main-steam stop. This eases sudden drop in pressure and corresponding decrease in temperature of inner surface of boiler drum
4. We shut off supply of feedwater to drum. No attempt is made to maintain water level in drum after fires are out
5. After zero pressure is reached, we follow normal shutdown procedure. Boiler is not emptied until furnace has cooled enough to permit an operator to remain inside the furnace



1 NIAGARA FALLS. Average flow in Niagara River is about 200,000 cfs. Under 327-ft head between Lakes Ontario and Erie, it could develop about 6 million hp. Plan, if applied in U.S. and Canada, will justify installing about 5 million hp

Proposed Plan Would Triple Niagara's

On U.S. side, over-all development would increase installed capacity from 445,000 to 1,690,000 kw, annual kwhr from 3.7 to 11.6 billion. Included is 375,000-hp pumped-storage plant

PRESENT WATER DIVERSION AND POWER GENERATION AT NIAGARA

Plant name	Net head, ft	Installed capacity, kw	Max water use, cfs	Max kw per cfs	Average daily water allotment, cfs
United States					
Schoellkopf	215	365,000	23,400	15.6	23,700
Adams	135	80,000	8,800	9.1	8,800
Total		445,000	32,200		32,500
Canada					
Queenston	294	373,000	17,030	21.9	15,200
Ontario	180	138,000	11,100	12.4	10,700
Toronto	137	108,000	15,500	7.0	15,000
Rankine	135	80,000	10,600	7.6	10,600
DeCew	280	149,000	7,600	19.6	3,930
Total		848,000	61,830		55,430

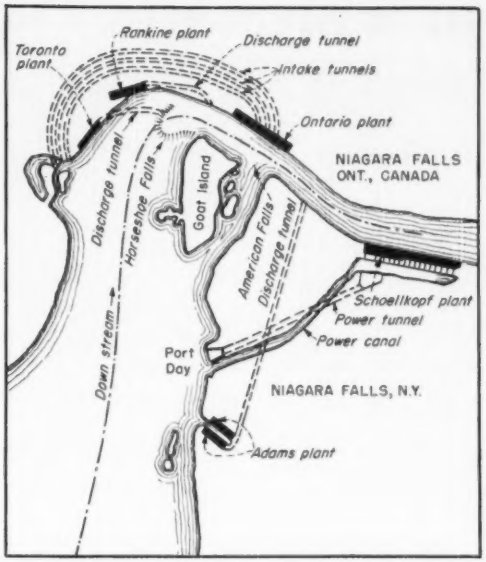
► AFTER A LAPSE of over 20 years, hydroelectric-power development from Niagara River is again receiving attention. Recently the Federal Power Commission made public a report outlining a redevelopment plan of the U. S. side of the Falls.

Because of this report it is interesting to compare present power developments on the Niagara with those that are proposed.

American Plants. Map in Fig. 2 shows the plants and how they were developed. Adams, the first large plant to be built, is now rated 80,000 kw. It takes water direct from the river through penstocks to water-wheels near the bottom of a deep cut in the rock. Discharge from these wheels flows through a long tunnel, shown in dotted lines, into the river below the American Falls.

Schoellkopf plant is rated 365,000 kw. Water for ten 10,000-hp and three 37,500-hp units comes through a canal. Water for the last addition to this plant, three 70,000-hp units, comes through a tunnel to a forebay above the plant.

Canadian Side. There are three plants. Toronto, rated 108,000 kw, takes



2 PLANTS AT THE FALLS. Location of the five plants in the U.S. and Canada, and the various kinds of developments

3 OVER-ALL DEVELOPMENT. Tunnel from Schoellkopf plant and canals from Connors Island run to plant at Lewiston

Generated Power

water direct from the river above the Falls and discharges through a deep tunnel under Horseshoe Falls. Rankine plant, with 80,000 kw installed, also takes water direct from the river and discharges through a deep tunnel below the Falls. Ontario plant takes its water from the river above Toronto plant. This water is conducted through three tunnels to the top of the river bank below the Falls. From here it goes to a 138,000-kw plant on the river's edge.

In addition to the plants at the Falls two over-all developments were made in Canada. The Queenston project, Fig. 3, turns the flow of Welland River for about 4 miles, and then conducts the water through a long canal to a 373,000-kw plant at Queenston to use a total head of 315 ft of the 327-ft fall between Lakes Erie and Ontario. The other over-all development. DeCew Falls, takes water from Welland Canal into Lake Gibson and over Niagara Escarpment to operate a 149,000-kw plant under a 280-ft head. This plant discharges into Lake Ontario at Port Dalhousie.

Rankine plant, owned and operated by the Canadian Niagara Power Co, is licensed in Canada to produce 75,000 kw. All the other plants are owned and operated by the Hydro-Electric Power Commission of Ontario.

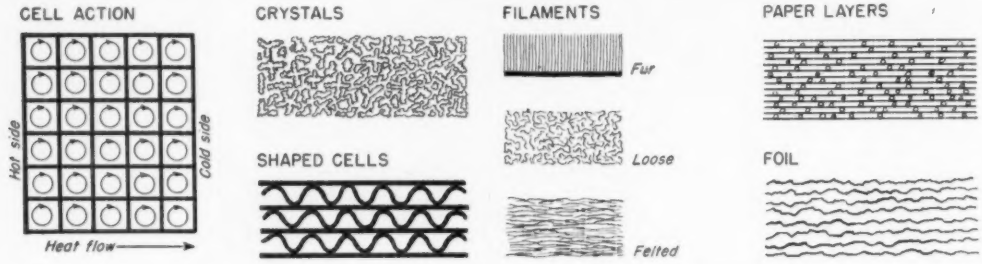
Total Capacity. Power plants on Niagara River and Welland Canal in Canada and in the U.S. have total capacity of about 1,300,000 kw. All plants are in operation. Total water being diverted for power use is 87,930 cfs. This includes 5000 cfs resulting from diversion from Hudson Bay watershed into Lake Nipigon and down Nipigon River into Lake Superior. It also includes 1430 cfs being used through DeCew plant, but not 370 cfs diverted before the 1909-10 treaty and now used for sanitation and power along Welland Canal. Of the total water diverted, 32,500 cfs are used through U. S. plants, and 55,430 cfs through Canadian plants. During the non-navigation season an additional 2500 cfs is diverted through Welland Canal to DeCew plant. This agreement will end in April 1951.

The table summarizes the water diversion and power generation along Niagara River. About one half of the power generated in Rankine plant and nearly all from 4000-cfs emergency diversion goes to the U.S. This might appear to bring power from water diversion into near balance in the two countries. But the head under which water is used from the different diversions results in a greater net power for Canada. This higher head for use of water in Canadian plants is indicated in the table under the heading, "Maximum kw per cfs." The Queenston plant has the highest with 21.9 kw per cfs, followed by DeCew with 19.6 kw per cfs. In the U.S., the Schoellkopf plant has the highest generation with 15.6 kw per cfs. Plants on the two sides of the river are about equally efficient, so the difference in power generation per cfs is due largely to difference in head under which the water is used at the plants.

Proposed Changes. Power-development changes along the Niagara River on the U.S. side have to do almost entirely with using the water under increased head and more diversion. They include a tunnel starting below Schoellkopf plant and running to Lewiston. Water is to be diverted from Niagara

(*Continued on page 154*)

ALL INSULATION TRAPS DEAD AIR IN TINY POCKETS



DEAD AIR SPACE DOES THE JOB in most types of insulation. Primary path for heat transfer across an air space is by convection. If air spaces are tiny, and there are many, convection currents can't really get going and resistance is high

Insulation Handbook: Part 2

Types and Shapes of Heat Insulation

Here Editor Phil Swain explains how insulation does its job, lists data on forms, temperature limits. Future articles will cover heat loss, economic thickness, selection, application

► THIS ARTICLE EXPLAINS why certain materials are good insulators. Then it briefly describes materials and shapes in common commercial use for insulating heated surfaces.

Why Insulation Insulates. It is generally understood that insulation depends on "dead air," but just how dead air works is not always clear. Heat flow through air is mainly by convection because air is a poor conductor. That is why every good heat insulator must: (1) lock air in small pockets so convection can hardly operate (2) leave only very little solid material running in heat-flow direction.

The sketch at top left shows the ideal condition if the cells pictured are assumed to be microscopic in size, and the solid walls running in the direction of heat flow very thin.

View each cell as a hurdle the heat must overcome. At each cell the heat, after passing easily through the left thin wall must pass to the air in the cell, then circulate to the right wall by natural convection, and there give up its heat.

Repeating this operation many times per inch of thickness can build up a great total resistance to heat flow even if the material itself (as with aluminum-foil insulation) is a very good heat conductor. For aluminum, note that the bright reflecting surfaces are additional important barriers, this time to radiant heat.

Stiff or Efficient? Most commercial insulations are a compromise between insulating qualities and other qualities needed for specific applications. For example, where insulation is compressed, or binder added, to increase strength and stiffness, some insulating efficiency is almost always lost.

In general almost anything to increase stiffness and strength (other than some kind of protective shield) increases weight, reduces insulating value. Thus insulating brick and "hard-finish" asbestos cements have lower values than the usual 85% magnesia and mineral-wool insulations.

Every form of insulation has some upper temperature limit beyond which it cannot be used without shortened life or early destruction. Thus insulation of hair and wool is rarely used above 200 F. In ordinary "air-cell" asbestos insulation the binder often sets a safe upper limit of 300 F; 85% magnesia calcines if applied direct to pipes hotter than 600 F. Even asbestos, often viewed as a near refractory, loses strength far below red heat.

Table on facing page roughly classifies insulations by substance and shape. Complete consistency isn't possible in this sort of table. To avoid confusion and reduce generalities to a strictly practical level, future articles will consider properties of magnesia, mineral wool and other insulations—also methods of applying them to various surfaces and equipment types.

Also, special problems in insulating cool and cold surfaces will be covered in a separate article.

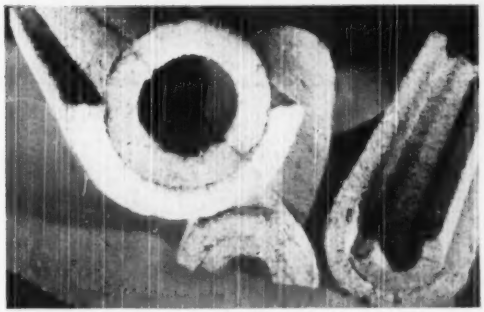
Here are a few high-spot comments:

Organic Fibers. Fibers of hair, and of wool, can be felted (loosely interlaced). This felt can be formed into sectional pipe covering, blocks, or into sheets pliable enough to fit over curved or irregular surfaces. This organic insulation should not be used at temperatures above 200 F.

Asbestos Air Cell. This low-cost insulation (layers of corrugated asbestos paper) is used chiefly on domestic steam and hot-water lines—rarely for permanent industrial lines. Seldom used above 300 F.

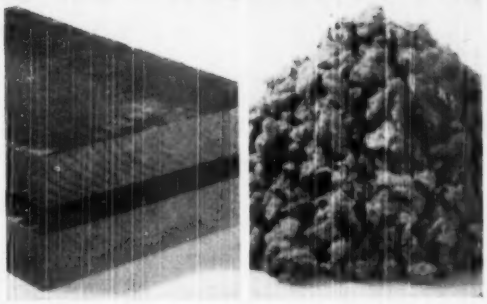
Other Asbestos. Asbestos fibers may be "felted" to form sheets and blocks and pipe covering. Any of these shapes can be made stiffer and stronger by adding binder, but always at the ex-

COMBINATION INSULATION



FOR STEAM PIPES above 600 F, diatomaceous-silica inner layer protects outer of more efficient 85% magnesia insulation

MINERAL WOOL



MINERAL WOOL is supplied in many forms, including boards, *left;* loose and noduled wool, *right,* blankets, batts, cements

pense of some loss in the efficiency.

The same holds true of asbestos cement. The greater its cementing quality (hardness, strength, weight) the poorer its insulating quality. Thus soft cements of high insulating quality are commonly given a thin finishing coat of hard-finish cement, applied mainly as a protection.

Mineral Wool is made by exposing a thin stream of molten slag (or glass) to a high-velocity steam jet. Primary product is a woolly mass of tangled mineral fibers. In this form—poured loose, laid out flat as a batt or blanket (a layer of mineral wool sandwiched between wire mesh or other supporting layer)—it has high efficiency. This efficiency is somewhat reduced when material is strengthened and stiffened by compacting, felting and by adding binder to form boards and blocks.

85% Magnesia, a nonproprietary product, consists of 15% by weight asbestos fiber reinforcement and 85% carbonate of magnesia, chemically derived from dolomite rock. Insulating value comes entirely from microscopic air spaces between magnesia crystals.

Because of its character 85% magnesia cannot be felted. It is formed by wet molding. Commercial forms are sectional pipe covering, blocks, segments and cement.

For pipe temperatures above magnesia temperature limit of 600 F insulation is applied in two sectional layers—inner layer of temperature-resisting diatomaceous silica, and outer of the more efficient 85% magnesia.

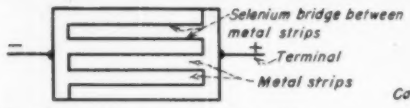
High-temperature diatomaceous silica insulations are made up to 1200 F—even up to 1900 F. Insulating refractories are obtainable (for backing furnace firebrick) for temperatures up to 2500 F.

KINDS AND SHAPES OF HEAT INSULATION FOR WARM SURFACES	Hair felt	Air-cell asbestos	Asbestos, fibrous	85% Magnesia	Sponge-felted asbestos paper	Mineral wool	Diatomaceous silica (calcined)	Diatomaceous silica (calcined brick)	Crumpled aluminum foil
Usual maximum temperature	200 F	300 F	750 F	600 F	700 F	1000 F	1900 F	2500 F	
Poured loose or granulated				✓		✓	✓		
Cement			✓	✓		✓			
Blankets or batts	✓	✓				✓			
Sheets (flexible)		✓	✓		✓	✓			✓
Boards or blocks (stiff)		✓	✓	✓	✓	✓	✓		
Molded segments				✓					
Shaped sections	✓	✓	✓	✓	✓	✓	✓		
Bricks								✓	

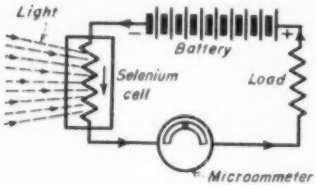
ELECTRONICS FOR THE POWER ENGINEER

By F A ANNETT, *Associate Editor*

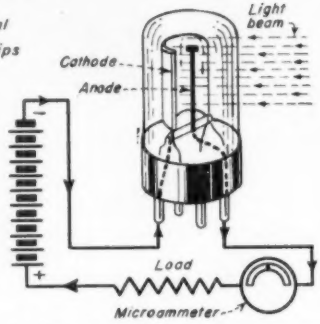
Four Classes of Photoelectric Devices



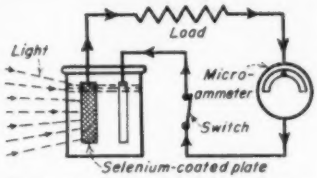
1 Photoconductive or selenium-resistor cell, oldest light-sensitive device



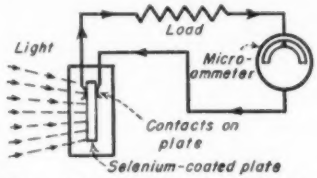
2 Connect selenium-resistor cell in a circuit; current flows as indicated



3 Photoelectric tube has small anode and large light-sensitive cathode



4 Liquid photovoltaic cell is similar to a wet battery with two electrodes



5 Dry-disk photocell has a single disk, one side of which is selenium coated

23—What Are Photovoltaic Cells?

► WHEN WE STUDIED disk-type rectifiers we learned that a metal plate with a thin layer of selenium or copper oxide acts as a rectifier. That is, it offers high resistance to electric-current flow in one direction, and low resistance in the opposite. Properly made, these plates also generate a voltage when light shines on the selenium or copper-oxide layer.

Devices using these disks are called light-sensitive cells, photoemissive cells, photocells, photovoltaic cells, photoelectric cells and photonic cells. They are electronic in operation and are developed for many applications. Among these are light meters used for (1) photography (2) measuring light intensity in rooms and other places (3) determining amount of ingredients in a solution (4) high-temperature pyrometers (5) smoke meters (6) control of street lighting (7) counting (8) sorting (9) operation of alarm systems.

Photoelectric devices fall into four classes: photoconductive cells, photoelectric tubes, photoelectric liquid cells and photoelectric dry cells. The last two are called photovoltaic cells. To get our thinking straight, let's consider each of the four in turn.

Photoconductive Cell. The photoconductive or selenium-resistor cell, Fig. 1, is one of the oldest light-sensitive devices. Selenium is an element that lies between an insulator and a conductor. It has the unique quality of changing its resistance to current flow when exposed to light.

Selenium resistors usually consist of an insulator plate on which is deposited a thin-metal film, such as gold leaf. This film is divided into strips with a thin dividing line between them, alternate strips being connected, Fig. 1. A thin layer of selenium deposited over the metal film forms a bridge across the dividing lines between the strips.

When such a resistor is conected in series in a circuit, Fig. 2, current flow varies with amount of light reaching the selenium. Current flow increases as light intensity on the selenium increases, and decreases as light decreases. The device, therefore, provides a means of controlling by light the current flow in a circuit.

Note that this cell does not generate a voltage, but is only a current-conducting device whose resistance changes when exposed to light, much as the resistance of most conductors changes with temperature.

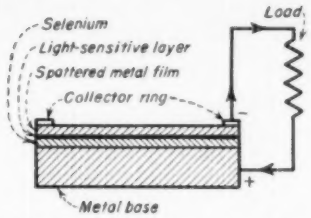
Photoelectric Tube. A photoelectric tube, or phototube, Fig. 3, has an anode and a light-sensitive cathode in a high-vacuum or gas-filled bulb. Its cathode is usually semi-cylindrical, and its anode a straight wire or wire ring. The cathode is coated with light-sensitive material, such as oxides of cesium, barium, sodium or potassium.

Exposing the light-sensitive material on the cathode to light causes it to emit electrons the same as heating the cathode releases electrons in a hot-cathode tube. In Fig. 3 the cathode is connected to the battery's − terminal and the anode to the +, as for a hot-cathode tube. As long as light shines on its cathode the tube conducts as indicated. Interrupt the light beam and the tube ceases to conduct. This device is another that does not generate a voltage, but controls current flow by a light beam. When not exposed to light, the phototube acts as an open switch in the circuit, whereas under the same conditions the photoconductive cell, Fig. 2, has maximum resistance to reduce current flow to a minimum but not completely interrupt the circuit.

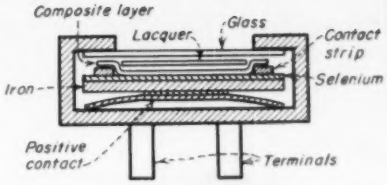
Photovoltaic Cells. There are two classes, wet and dry.

The liquid cell, Fig. 4, is like a wet battery with two plates, or electrodes,

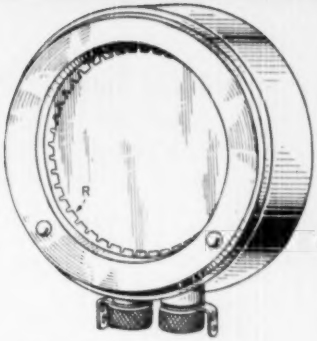
Dry Type of Photovoltaic Cells



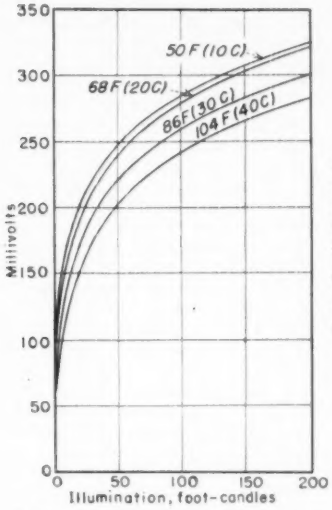
6 In a photovoltaic cell, current flows from selenium layer to the metal base



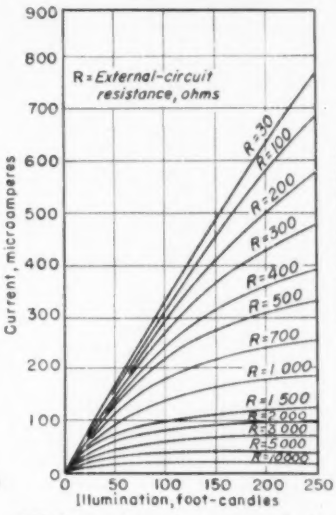
7 A cross section through one design of a commercial photovoltaic cell



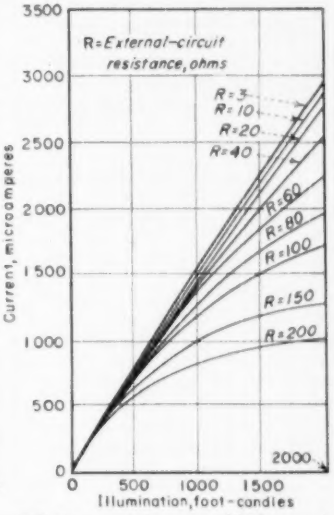
8 Assembly of a photovoltaic cell with contact ring *R* on negative electrode



9 The voltage of photocells is low and depends on the light reaching them



10 Current from selenium-iron cells depends on circuit resistance and light



11 Characteristic curves of high-current and high-light-intensity photocell

immersed in an electrolyte. One of the plates has a thin film of selenium placed so it can be exposed to light.

When light shines on the selenium plate a voltage is generated between it and the other plate. So a battery is not required in the circuit with this cell as it provides its own voltage. When the cell is connected in a circuit, as in Fig. 4, a current flows as long as light shines. This cell has a comparatively high current output for devices of this kind. But when supplying a current it generates a gas, becomes unstable and worthless in a short time. It also has the disadvantage of containing a liquid that makes it unsuitable for portable purposes. This led to the development of the dry or disk-type photovoltaic cell, Fig. 5.

Cell Construction. This cell consists of a disk, one side of which has a thin layer of selenium. When connected in series in a circuit as shown, a current flows when light shines on the light-sensitive layer. This cell is a device for directly converting light energy into electrical energy without altering the structure of the cell. Under proper conditions current flow varies almost directly as the amount of light reaching the cell. This makes it suited to a wide variety of applications.

Fig. 6 shows a cross section through a photovoltaic dry cell. It consists of a metal base on which is deposited a very thin layer of selenium. On the selenium is spattered a very thin layer of metal, such as gold or silver, on which the current-conducting electrode rests. The metal is so thin that it is transparent. When light shines on the cell a current flows from the selenium layer to the metal back plate as indicated. The action in this device is electronic. Several theories about it have been advanced, but none has been generally accepted.

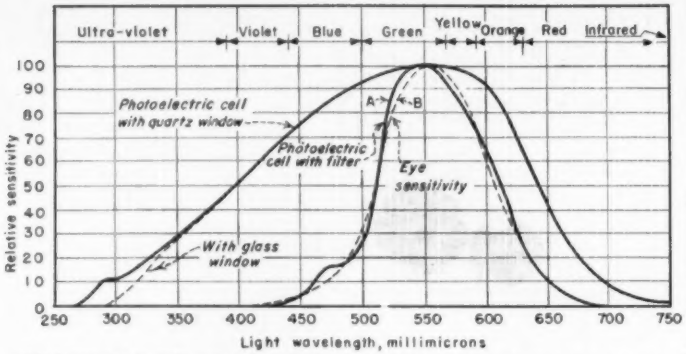
Fig. 7 is a cross section of one design of commercial photovoltaic cell. It consists of a thin-iron back plate with a thin layer of selenium on one surface. Over this layer are deposited several extremely thin layers of conducting metals. This composite metallic layer gives the cell its stability and high output rating.

With the exception of the electrical contacts the light-sensitive surface of the cell is covered with a transparent coating of plastic to protect it against atmospheric conditions. The cell is enclosed in a hard plastic case with a glass plate in its window. Terminals for external connections are provided on the back of the case.

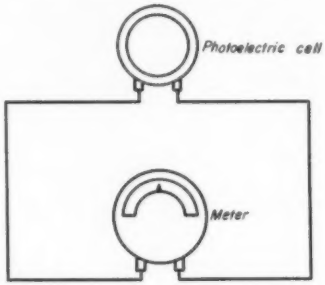
Fig. 8 shows the assembly of another design of photovoltaic cell. Contact ring *R* on the semi-transparent negative electrode serves as the electron-conducting surface.

The light-sensitive layer in photo-

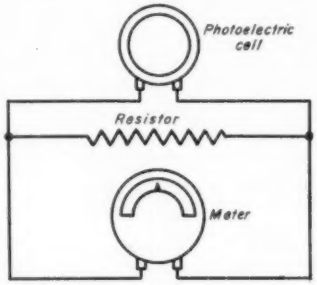
Curves Compare Photo Cells With Human Eye



12 Photovoltaic cells are sensitive to all the light that the human eye can see and, in addition, they are sensitive to the ultraviolet and the infrared rays



13 Simplest connections of a photovoltaic cell to microammeter or relay



14 Connecting a resistor across cell's terminal will improve its response

voltaic cells uses several materials. These include copper oxide, selenium, tantalum, tellurium and others. Except for special purposes almost all photovoltaic devices use selenium for the light-sensitive layer, but it is applied in different ways in different makes.

Cell Voltage. Voltage produced by photocells is low and depends on the amount of light reaching them and their temperature, Fig. 9. At 50 F and 200 foot-candles of illumination, voltage reaches about 325 millivolts (0.325 v). Other conditions remaining unchanged, when illumination drops to 20 foot-candles the voltage decreases to about 200 millivolts (0.2 v). At lower temperatures, voltage is a little higher, and at higher temperatures voltage decreases. For example, at 200 foot-candles and 104 F, voltage is 280 millivolts, and drops to 150 millivolts at 20 foot-candles.

Current output of selenium-iron photovoltaic cells depends on external circuit resistance and illumination intensity, Fig. 10. These cells for 250 foot-candles illumination and 30-ohms external resistance deliver a current of 760 microamperes. This current decreases almost in a straight line to zero illumination. Such a characteristic is required for light-measuring devices, because their scale can be uniformly divided and they will give a correct reading at any light intensity.

External Resistance. As the external resistance is increased the current curves slope more and more toward the horizontal until at 10,000 ohms the curve is practically horizontal beyond 50 foot-candles. The reason is that, as the external resistance increases, the electrons released by light energy cannot flow away freely. As a result, they leak back to the selenium layer.

The greater the external resistance, the fewer the electrons that flow away from the light-sensitive surface; more leak back to the selenium from which they came. This action is somewhat similar to that in a thermionic tube. Electrons are released from the hot cathode, but if the external circuit is open they return to the cathode. If the anode is made positive through a high-resistance circuit, some of the electrons flow to the anode, through the external circuit, back to the cathode. The rest of the electrons released return directly to the cathode without leaving the tube. The lower the external resistance, the greater the number of electrons that flow to the anode and through the external circuit; fewer are attracted back to the cathode within the tube.

Current Characteristics. Different photovoltaic cells have different current characteristics. For example, one design at 14 foot-candles and 100-ohms external resistance delivers 50 microamperes at its maximum rating. At the other extreme, a cell designed for 2000 foot-candle illumination delivers about 3000 microamperes through 3-ohms external resistance, Fig. 11.

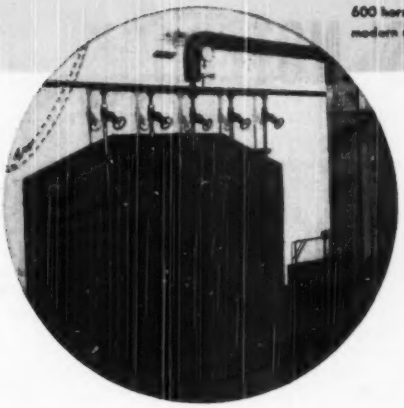
Fig. 12 shows that photoelectric cells are sensitive to all the light the human eye perceives and, in addition, they are sensitive to ultraviolet and infrared. Both have maximum sensitivity to light of 550 millimicrons wave length, which is in the green range of the spectrum. Incidentally, a millimicron is one millionth of a millimeter (0.000001 mm). This makes the cells well suited to measuring illumination the human eye is to work under. Filters have been developed that make the light sensitivity of a photoelectric cell duplicate very closely the average visibility curve of the eye, as indicated by curves *A* and *B*. For many applications, correction for light sensitivity is not necessary.

Measuring Light. Photovoltaic cells provide a simple, inexpensive way of detecting and accurately measuring light. They are developed to a point where they have comparatively high output, long life, and are stable in operation. They are simple to install and operate, because they are self-generating and do not require an auxiliary power supply. Since the cells do not depend on chemical change to generate electricity, but convert light energy directly into electrical energy there is no tendency for output to decrease because of use, when the cells are used under proper conditions. One of these conditions is not to expose the cells to temperatures over 140 F (60 C).

These cells have no dark current and drift. They are not subject to erratic changes. When initially exposed to a light source, however, current output of the cell falls off slightly with exposure, so a short interval may be required before cell output reaches a constant value. Therefore, where high accuracy is required, wait a minute or more before taking readings.

Speed of Response. The cells' speed of response to light changes is so much more rapid than that of meters and

(*Continued on page 164*)



600 horsepower boilers—boiler room installation in modern office building, Wilmington, Delaware

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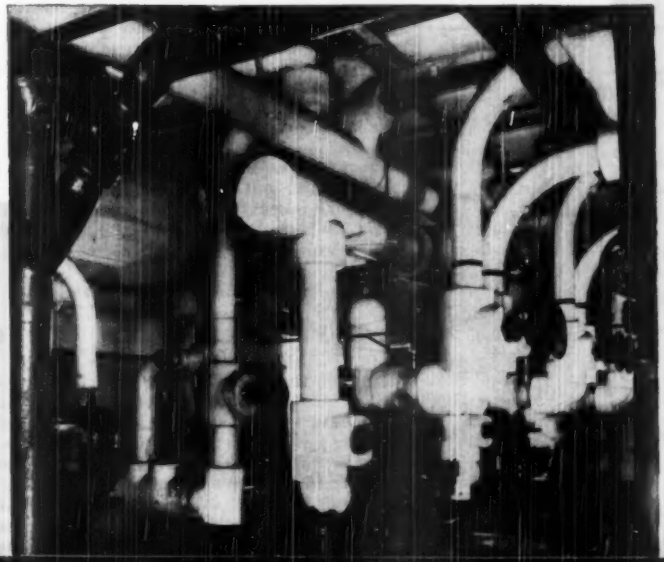
Benjamin F. Shaw Company is qualified to pre-fabricate and erect piping throughout the world.

President



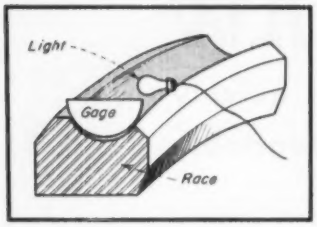
Piping leading to the boiler feed pumps was pre-fabricated and installed by the Benjamin F. Shaw Company. Of interest, this is one of the few boiler rooms in the country spotlessly finished in white enamel.

KNOWN SINCE 1893 FOR HIGH-QUALITY PIPING PRE-FABRICATION AND INSTALLATION

POWER ENGINEERS' NOTEBOOK

PLANT-TESTED IDEAS TO SOLVE PROBLEMS OF DESIGN, OPERATION AND MAINTENANCE

GAGES SPEED UP PULVERIZER BALL SELECTION



IN OUR BALL-AND-RING PULVERIZERS we find it economical to wear out two sets of grinding balls to each set of rings. We follow the standard procedure of alternating sets of grinding balls, replacing each set with one a little larger in diameter.

We were faced with the problem of determining quickly the largest ball size we could substitute when a mill was taken down, and still conform closely to the ring-groove radius. For a while we did it by trying certain size balls. This meant extra work in lifting the balls into and out of the mill. It was hard to determine how well they fitted because the ball itself blocked the view of the bottom. We now use a set of gages, which we made ourselves.

These gages are half circles of masonite board, ⅜ in. thick. To make them we laid out circles on cardboard, starting with 9¼-in. dia, down to 6-in. dia in steps of ¼ in. These circles were cut out carefully and then cut in half. With the halves as templates we cut the masonite gages.

Another method lays out half circles on sheet metal for ring-radius gages.

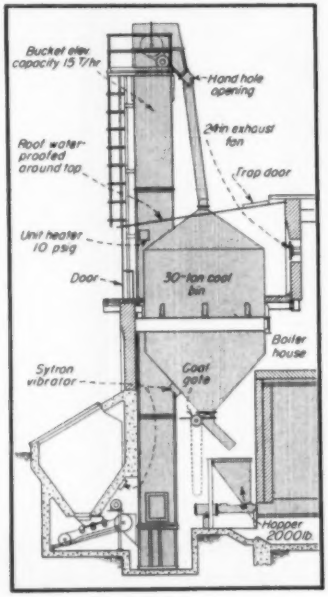
To use the gages, open the mill door, select one of them, and slip it between the rings. Hold a light behind it and note how well it fits, as indicated in sketch. Try various sizes until the correct one is found. Size between the ¼-in. steps can be easily estimated.

We found it possible to use larger size balls than indicated by the old cut-and-try method. Speedier repair and better fit have resulted.

W M LUCAS *Henderson, Ky.*

ENCLOSING COAL BIN SOLVES CHRONIC FREEZING PROBLEM

FOR SEVEN YEARS we had been troubled by coal freezing in our steel overhead outdoor bunker. Wherever this happened we had to call men out, often at night, to get the coal flowing again. We tried spraying it with calcium chloride and with oil. We also tried using steam coils in the bunker, but these and other methods did not solve the problem.



With no success by simpler measures, the obvious thing was to protect the bunker completely from the weather. We enclosed it, as shown in the sketch, with two layers of ¾-in. pine boards and one layer of thick insulating paper. A sloping roof made thoroughly watertight completed the enclosure.

The housing abutted the upper boiler-house wall. We knocked an opening through this wall and installed a large exhaust fan to pull hot air out of the boiler room to surround the coal bin. To supplement this heating we installed a unit heater on the outer wall of the enclosure. This comes into use during subzero weather and when the boilers are shut down.

In addition to these improvements we installed vibrators to help keep the coal flowing whenever it tends to arch. Since making these alterations boiler operators have had no more coal inconveniences.

G A AIKEN *Leominster, Mass.*

RIG HANDLES LARGE PIPE THREADERS EASILY

HANDLING THE STOCK to cut threads on 5- and 6-in. pipe was quite a job. Two men had to raise and lower it from working position each time. To cut down manpower and make the operation safer we adapted some salvaged door rails to our needs.

We placed two of the door rails parallel to each other and welded them to ceiling beams above the work bench. Iron plates welded at each end of the rails acted as stops. A third door rail was mounted on pulleys to act as a crane and ride along the parallel rails.

Another set of pulleys was arranged to ride on the crane rail and carry a turnbuckle and hook. By operating the turnbuckle the hook can be raised and lowered.

A hook is welded on the stock, which is engaged by the crane hook. One man now handles the stock.

A V THEADO *Columbus, Ohio.*

(*Continued on page* 126)

NOW! AT NO INCREASE IN COST TO YOU

Makes a good steam trap better

Nearly 650,000 Yarway Impulse Steam Traps have already been installed—proof that they are doing a good job.

Now a *stainless steel* body makes this famous little trap even *better—at no increase in cost.*

Better in *wear*, better in *service*. Users will find Yarways require less maintenance than ever. All parts are wear-resistant, practically wear-proof. There is only one moving part, a small, stainless steel, heat-treated valve. Important, too—Yarway Impulse Traps are *suitable for all pressures up to specified maximum without change of valve or seat.*

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In performance—ask any user. They all say Yarways are the traps that *get equipment hotter sooner and keep it hot!*

For better steam trap performance, try *new* stainless steel Yarways.

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Write for name and address.

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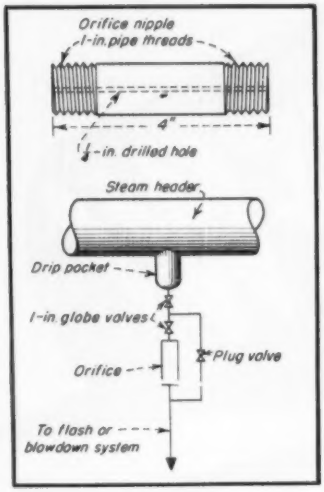
YARWAY IMPULSE STEAM TRAP

 (*Continued from page 124*)

ORIFICE NIPPLES PROVIDE ECONOMICAL STEAM-LINE DRAINAGE



TRAPS IN high-pressure superheated-steam lines usually operate during warmup periods only. During normal operation, line condensate seldom forms because heat losses through the insulation are not high enough. As a result traps may function only once a week or even less often depending on the plant load cycle.

Many traps in a superheated steam line call for a large investment. To reduce equipment costs we have used nipple orifices with excellent results. Upper sketch at left shows their simple construction. They are made from bar stock of stainless steel, 4 in. long. Both ends are threaded for 1-in. schedule-80 pipe. A ¼-in. hole drilled through the longitudinal axis forms the orifice. The hole must be carefully reamed and cleaned to remove all burrs and foreign material that might collect.

Lower sketch at left shows how the orifice hooks into the drip pocket. The practice used with traps is followed in providing a bypass valve around the orifice. Condensate from header or line passes through the nipple orifice to the plant flash tank, or continuous-blowdown system, where the heat is recovered.

After all the condensate drains following startup, a small amount of steam passes through the orifice while the line stays hot. Compared with condensate flow, steam flow is negligible on a lb-per-hr basis. For instance, at 350 psia and 700 F the specific steam volume is 100 times that of the condensate. The flash tank or blowdown system salvages the major part of the heat content in the steam.

Several of these orifices have been in successful operation for the past five years. Their low first cost, coupled with no maintenance needs, makes them most acceptable.

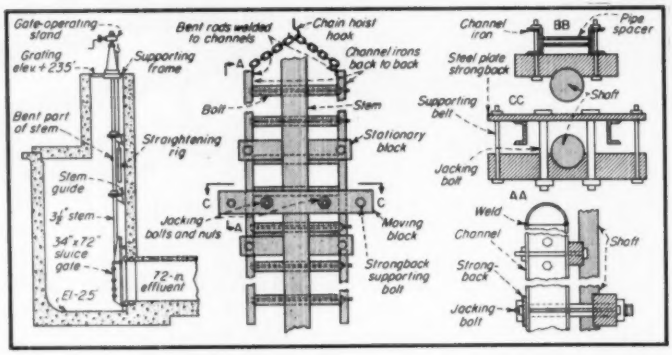
TYLER G HICKS *Summit, N. Y.*

SIMPLE RIG TAKES KINK OUT OF LONG VALVE STEM

IN OUR PLANT an 84x72-in. sluice gate in a 30-ft effluent pit has a 2-speed hand-operated stand, as in the left-hand sketch. One day two of the operators had the job of closing it. They had it in low gear and, without a brain cell working, tried to drive the gate through the pit floor. The bolts holding the gate stand to the operating floor didn't pull out, but the stem-guide hold-down bolts broke and the bronze valve stem bent. Despite the damage we managed to get the gate partly open later when we needed to do so.

Getting the plant back to full operation without too much outage time was our next problem. After studying several methods we decided to straighten the valve stem in place, with the rig shown in the sketch.

All iron and lumber were cut to size and shape, and assembled with bolts and rigging on the operating floor. At a period of low flow we closed the gate. Timbers were suspended from ropes in the effluent pit opposite the bent portion of the stem. Planks spiked into these timbers formed a 2-decker platform from which we worked. We set up the straightening rig as shown in the detail sketches. Heating the shaft with an oxyacetylene flame we took up on the jacking bolts gradually. The whole job was completed in a matter of four hours, including rebolting the stem guides.



This short time shows we made a good choice of method. It has been used to straighten propeller shafts and can also be used on large pipes of long running lengths.

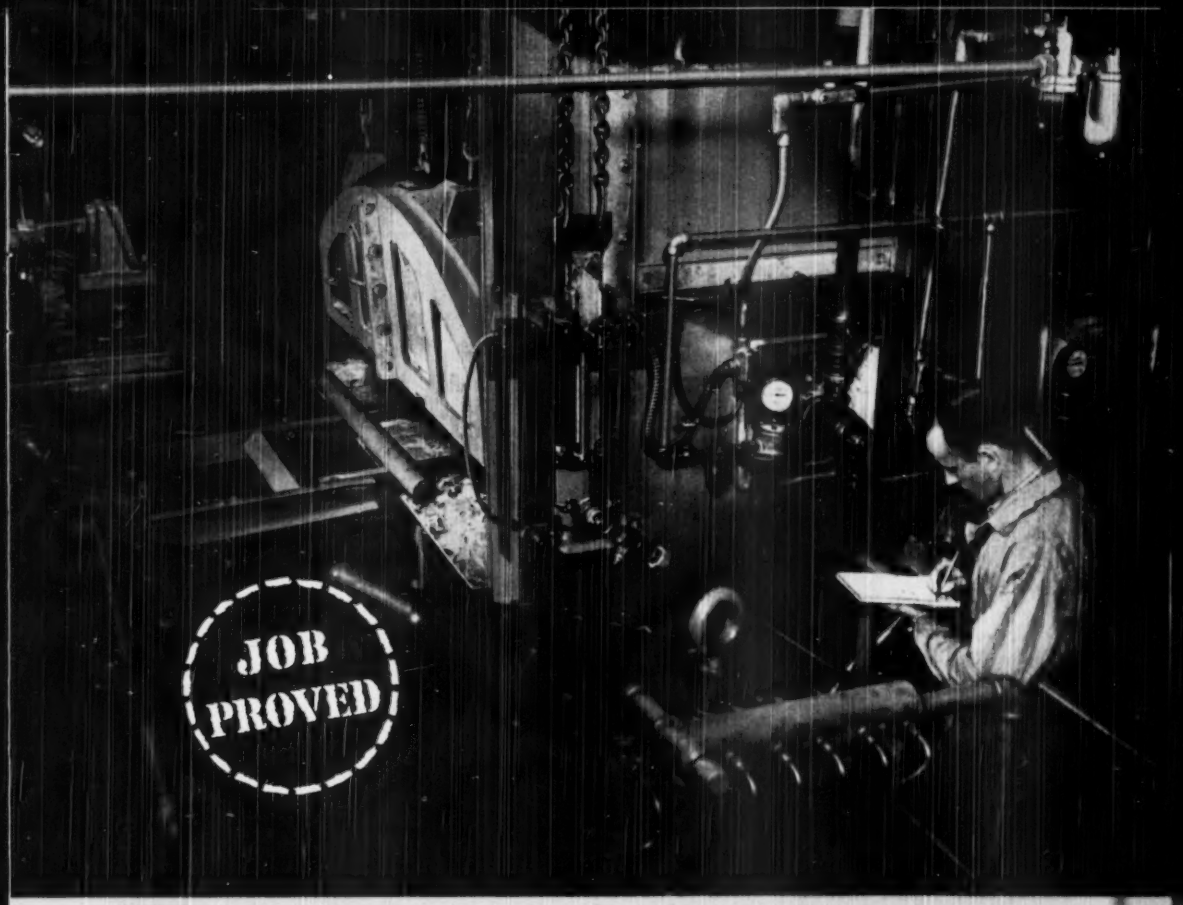
Here are a few notes on procedure to speed up the job:

1. Reinforce all wood with washers.
2. Moving and stationary blocks are timbers carved out to fit valve stem.
3. Stationary blocks are placed at straight section of stem before and after bend.
4. Moving or jacking block is put at center of "hump."

F J ARDOLINO *Brooklyn, N. Y.*

The Editors Invite Contributions From POWER Readers

Here's your chance to cash in on one of those professional tricks you have used in your plant. POWER pays $20 for each item published here on problems in design, operation and maintenance. Your contribution need be in rough form only—just set down all facts with sketches in pencil. We will do any editing that is needed.



HYDRAULIC SYSTEM KEPT LIKE NEW

Sunvis 916 Effects Substantial Savings; Strainers and Lines Kept Sludge-Free

A copper tubing manufacturer uses an oven with hydraulically operated doors to heat billets to approximately 1550F. The ambient temperatures around the hydraulic mechanism are abnormally high, putting the hydraulic fluid to a severe test of stability. Failure of the system would halt the piercing operation and result in costly delays throughout the plant.

Since the oven was first put in operation, three years ago, the hydraulic fluid has been Sunvis 916. The original charge has never been changed and is still in excellent condition, though the system is tight and requires only a minimum of make-up. Oil lines and strainers are completely free of sludge. Seals and packings are sound. Operations are never interrupted for oil changes or parts maintenance. The company expects to retain the original charge of Sunvis 916 in service indefinitely, effecting large savings in both oil and maintenance costs.

Sunvis 916 is a solvent-refined oil of the highest quality. It is fortified to resist the oxidation and sludging so detrimental to the efficient operation of hydraulic systems. Sunvis 900 Oils are *good for the life of your machines*. For your copy of the illustrated booklet "Sunvis 900 Oils" write Department P-3.

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PROBLEMS FROM THE PLANT

READERS ANSWER THE DECEMBER QUESTION...

Can Hydraulic-Elevator Water Circuit Condense Steam?

In operating the power plant of a large office building, here's one that has me stumped.

We have 18 hydraulic elevators. The plunger of those traveling full building height reaches a distance of 385 ft in the earth. That represents a lot of water pumped in and out of each elevator cylinder, especially during peak-loads.

Here's the question . . . Can we use the water from hydraulic elevator system as condenser cooling water for a small turbine? We have in mind a small steam turbine-generator to handle peak electrical loads. This is necessary because, as load has grown, generating capacity hasn't kept pace.

With the hydraulic-elevator-condenser idea, heat from turbine exhaust would be transferred through a steam condenser to water of the elevator lift system. Elevator water, in turn, would carry off this heat and transfer it to the earth through the piston cylinder. Note from sketch [POWER, *Dec 1949, p 132*] *that we plan to install the heat exchanger in pipeline to elevator cylinder.*

Before I figure out thermal and mechanical details, perhaps readers can head me off if I'm wrong.—MA

THE ANSWERS

Cylinder Expansion

AN IMPORTANT FACTOR in this scheme is the amount of heat that can be transferred through elevator cylinder to the surrounding earth. Normal earth temperature around the elevator cylinders will be about 55 F, earth thermal conductivity is not high and heat transfer will be further impeded by cylinders' preservative coating.

High heat-transfer rate could be obtained by working the circulating water at a high temperature. But that introduces further problems. For instance, a 25-F rise will cause cylinder to lengthen by about ¾ in. Then if lower end is resting on bedrock, buckling might result depending on type of support at upper end. Thermal expansion might also affect clearances of the plunger, skate and stuffing-box packing.

The 385-ft cylinder will hold about 10,000 lb of water when full (that's an out-and-out guess) and a round trip of the elevator takes about five minutes. Assume the condenser requires 50 lb of water per lb of steam and turbine steam rate is 20 lb per kwhr. Then one elevator might take care of the cooling-water requirements for a 120-kw turbine-generator set, if heat transfer from water through cylinder to earth is satisfactory.

Remember, locating condenser in line to elevator cylinder will cause a water-pressure drop. This head loss will depend on size and design of condenser and on water-flow velocity. Sizable drop in pressure might affect elevator performance. But locating condenser on suction side of elevator pump might result in part of the hot water flashing into steam as it is drawn into the pump. This would also affect elevator performance.

If a number of elevators discharge into a common tank, it might be advisable to install a separate pump for circulating water through the condenser, with suction and discharge ends in the common tank. This would spread over several elevator cylinders the heat to be dissipated.

NORTON SAVAGE *Newark, N. J.*

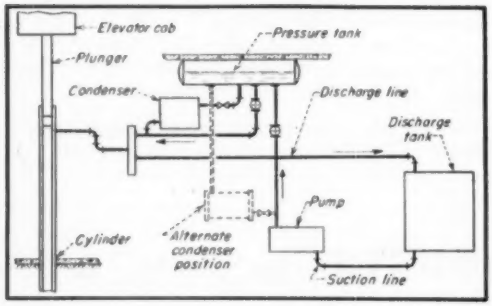
Run Practical Test First

HEAT TRANSFER FROM *MA's* elevator cylinders to the earth must equal heat given up by condensing steam, or about 1000 Btu per lb condensed. Total quantity of heat transferred through cylinder is primarily a function of temperature difference and time. I estimate that under normal conditions (cylinder full of water) 50,000 to 100,000 Btu per hr is transferred to the earth via 385-ft cylinder.

With water in full length of cylinder for 30 min in every hour, only 25,000 to 50,000 Btu can be transferred. *MA* could generate about 1 to 2 kwhr per cylinder with this heat-transfer rate.

But if water remained in the cylinder a shorter time, say, 10 min in every hour, he would have trouble. Temperature and heat content of water returning to discharge tank would gradually increase reducing condenser effectiveness. So best procedure would be a series of tests to determine actual temperature ranges obtained. By inserting

(*Continued on page* 130)



Alternate Piping Hookup

YES, *MA* can use the hydraulic system for cooling, but what kind of condenser (heat exchanger) is he considering? A jet type, where steam and water are in direct contact, or a surface condenser, where water circulates in the pipes, absorbing heat from exhaust steam, and condensate is returned to the boiler? He should use the surface type or the amount of water in the system will continually increase.

I suggest an alternate location for the condenser, as shown in the dotted lines in the sketch. Locate it between the pump and the pressure tank.

J YAVITCH *Philadelphia, Pa.*

FOR YOUR NEW QUESTION, TURN TO PAGE 130

Troubled with water problems?

SCALE

FOAMING

CORROSION

ALGAE

EMBRITTLEMENT

PRODUCT CONTAMINATION

STREAM POLLUTION

As an engineer responsible for efficient plant operation, are you troubled by these industrial water problems? If so, the Betz Organization can be of assistance to you. Here, in one organization, you will find the facilities and services necessary for the efficient solution of all industrial water problems. Wherever your plant may be located, our nation-wide staff of engineers is ready to serve you. May we have a Betz engineer call to discuss your specific problems? There's no obligation, of course. W. H. & L. D. BETZ, Gillingham and Worth Streets, Philadelphia 24, Pa. In Canada: BETZ Laboratories Limited, Montreal 1.

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a steam coil in the discharge tank, he can heat water to about 100 F and then read its temperature on return from the cylinder. If he consistently obtains a 20-F drop, the proposed installation is feasible. If not, a noncondensing turbine might be more dependable. Use of the atmospheric relief valve on a condensing installation during periods of small water flow would be difficult to justify on an economic basis because it would take a long time for steam savings to pay off the condenser and auxiliary equipment.

TYLER G HICKS *Summit, N. Y.*

Put Condenser in LP Line

ASSUMING ALL 18 ELEVATORS receive water pressure from the one pressure tank, it is theoretically possible to use this water for cooling. Allowable turbine size is governed by the following:

1. Earth's thermal conductivity is so low it is doubtful if enough heat can be dissipated in the elevator cylinders to operate a condenser efficiently.

2. Quantity of water to cool a small condenser effectively is relatively large and requires a reasonably steady flow. This is not possible in this type system since pumps are usually controlled by governors. These keep pump speed at point necessary to maintain operating pressure. Thus water flow through the condenser would be rapid at one time, and nil at another. Also, while the quantity of water handled by the pumps is large, actual quantity of water in the system is small. This presents the possibility that a great part of the heat absorbed from condenser will be returned to condenser with an accompanying decrease in efficiency.

3. Increase in water temperature would be harmful to elevator-plunger packing, pump piston and rod packing designed for cold-water service. *MA* should consider effect of temperature change on elevator plungers. There's a possibility of damage by warping of plunger or casing.

4. Pressures encountered in the elevator feed line are usually quite high. Hence condenser must be built to withstand these pressures. Another solution is placing condenser in cylinder discharge line where pressure is low.

W E TRANTUM
Redondo Beach, Calif.

A Few Basic Thoughts

USING WATER from a hydraulic-elevator system as condensing water has merit, but a number of points should be clarified.

1. How much heat in Btu must the condensing water carry? *MA* mentions a small turbine, but is there enough water in hydraulic system to maintain the stable vacuum necessary for efficient turbine operation?

2. Can required heat be successfully transferred to earth through plunger cylinder walls? How much heat-transfer surface is there, and what is its mechanical condition?

3. What is capacity of earth under the building to absorb and dissipate this heat under continuous future use? Although the plungers probably penetrate the water table, some groundwater movement may be needed to carry off the heat. This proposed system may cause a marked temperature rise should heat gradually accumulate.

4. Will the warmer water accelerate corrosion, cause plunger packing troubles, or raise other problems in pumping and piping systems? Pitting of plungers might lead to costly troubles later on.

5. Will an auxiliary heat-disposal system be required to carry a part of this load when elevators are not in operation?

GEORGE HOLMAN *Decatur, Ill.*

Can Be Done, But . . .

MA CAN PUT A CONDENSER in his hydraulic-elevator water circuit provided (1) there is a fairly continuous water flow through the condenser. When elevators are not operating a bypass should be used to hold flow through condenser (2) for each 1000 lb of steam condensed, about one million Btu's is transferred to the earth. Assuming the circulating-water temperature increase is 30 F, a flow of about 68 gal per min is necessary for each 1000 lb steam per hour condensed.

I suggest a recording flowmeter be placed in the water circuit to determine amount and regularity of water flow. If there is any doubt about the heat being transferred to the earth, as fast as it is absorbed in the condenser, a heater can be put in the circuit to simulate a condenser.

Above studies should determine what size turbine-generator can be added using the hydraulic-elevator water as condenser circulating water.

E W MCKNIGHT *Greenville, N.C.*

Consider Diesel Engine

ELEVATOR WATER can be used for condensing, but there are several things to consider. Don't connect condenser as in *MA's* sketch. Reason is that if an elevator stopped any length of time, water in condenser would get too hot. Then when elevator started, hot water would damage packing. Best bet is to provide a separate pump for condenser, with water circuit running from open tank to pump, to condenser, to open tank.

Also, consider that heat from pipes, plungers, etc, might cause discomfort during warm weather.

Keep the following in mind: Water gets warmer than it will in ordinary condenser practice; elevator-plunger

(*Continued on page* 172)

Oops! We Slipped. . . .

WE GOT OUR CRANKS and cams tangled in R E Fontaine's answer that appeared on p 126 of our January issue. In paragraph 5, line 6 the word "crankshaft" should be "camshaft."—*Editor*

THIS MONTH'S QUESTION

Can 25-Cycle Motor Be Used on 60 Cycles?

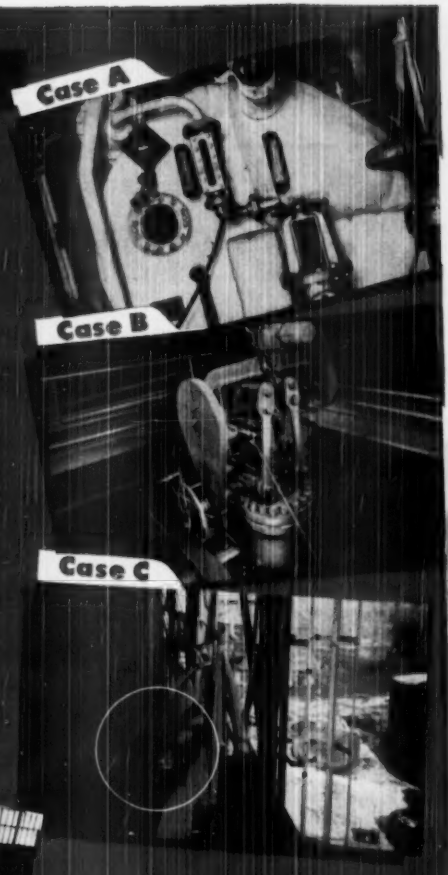
WE ARE CONSIDERING buying used 25-cycle motors and power transformers. Naturally our plant has a 60-cycle system. We can make good use of this equipment, if it is practical to convert both motors and transformers for use at the higher frequency. This 25-cycle equipment would fit into our setup only if it could be reconnected or rewound for 60-cycle operation. We have ruled out the use of a frequency changer as impractical in our case.

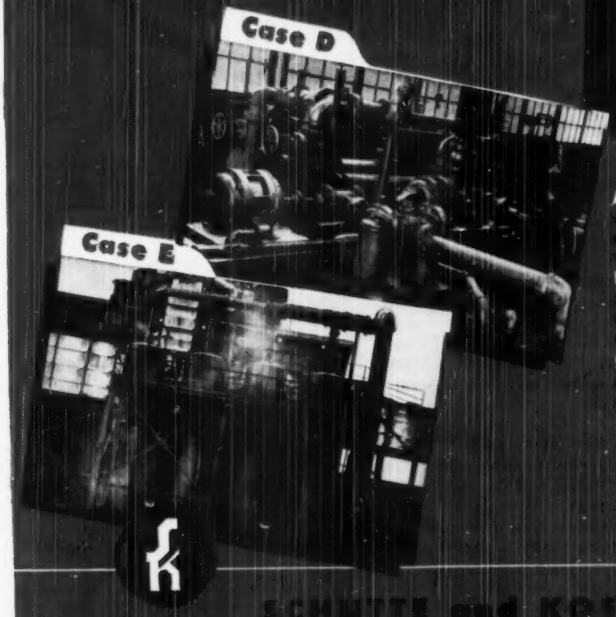
That brings up the first question: Can this equipment be used on 60 cycles merely by reconnecting the coil groups (for a motor) or does it call for a complete rewind? If rewinding is the answer will the hp rating remain the same? What about speed, frequency and efficiency? Will the motor operate at the same pf under new conditions?

Perhaps some of POWER's older readers have run into this problem and found a practical solution. At any rate we are holding off buying till we get an experienced slant.—*LT*

Exercise your engineering wits by submitting answers to this question, fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

CONFIDENTIALLY . . .





A.

B.

C.

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E.

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Manufacturing Engineers

TECHNICAL BRIEFS

ENGINEERING DEVELOPMENT HERE AND ABROAD DIGESTED FOR BUSY POWER MEN

REVIEWED IN THIS ISSUE

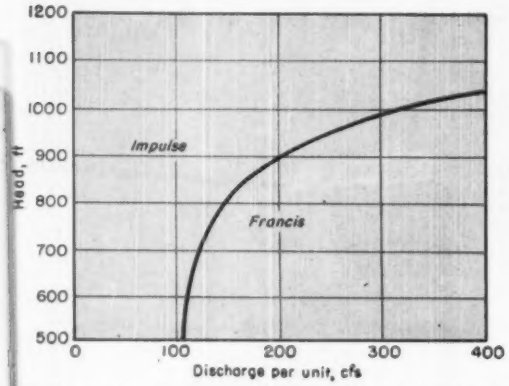
HYDRAULICS: Influence of Wear and Operating Conditions • Head and Flow of Free Centrifugal Pump Impeller

WATER TREATMENT: Deaerating Feedwater Heater Problems • Deaerating Heaters, Tray Type Vs Spray Type • Operations of the Ion-Exchange Water-Treating Plant • Hideout of Sodium Phosphate in High-Pressure Boilers

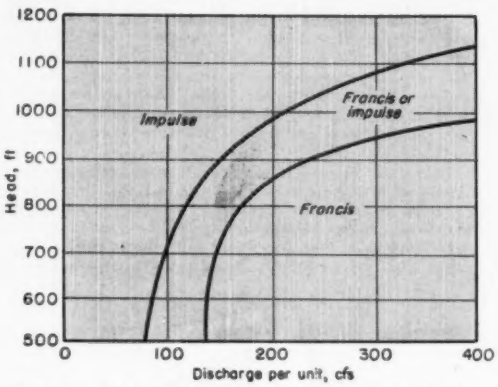
DUST COLLECTION: Cyclone Dust-Collector Design • Reduction of Pressure Drop Across Vortex Dust Collectors

STEAM: Evaluation of Steam-Power Plant Losses by Entropy-Balance • Selection of Steam Conditions for No. 4 Unit Riverside Generating Station • Comparison of Reheat vs Nonreheat • Factors Influencing Economics of Reheat Installations

Directions for ordering papers are given on page 134



1 Curve helps select the turbine type on head and discharge capacity only; but other factors influence each decision



2 Further aid to final selection of francis vs impulse turbine comes from above. Note area for the choice of either

Hydraulics

FRANCIS OR IMPULSE — THE INFLUENCE OF WEAR AND OPERATING CONDITIONS, *by A Puyo, Neyrpic, Grenoble, France.* When considering a hydroelectric project, there is sometimes a question whether a francis or an impulse turbine is more suitable. For a unit of 30,000 hp under 2500-ft head everyone agrees on the impulse turbine. Also, for a 300-ft head 20,000-hp unit, a francis wheel would be used. When we come to consider a 25,000-hp unit under 1000-ft head we find engineers who favor each type. The division line between the use of impulse and francis wheels as shown in Fig. 1 is not fixed and well determined, but depends on numerous technical and economic factors, which may vary with location and time.

The author discusses the situation as found in the present state of development of both types of wheels, studying the relative importance of various factors that weigh on the choice of francis and impulse design. The study is limited to heads of over 500 ft so as to confine the discussion to controversial units of a reasonable size.

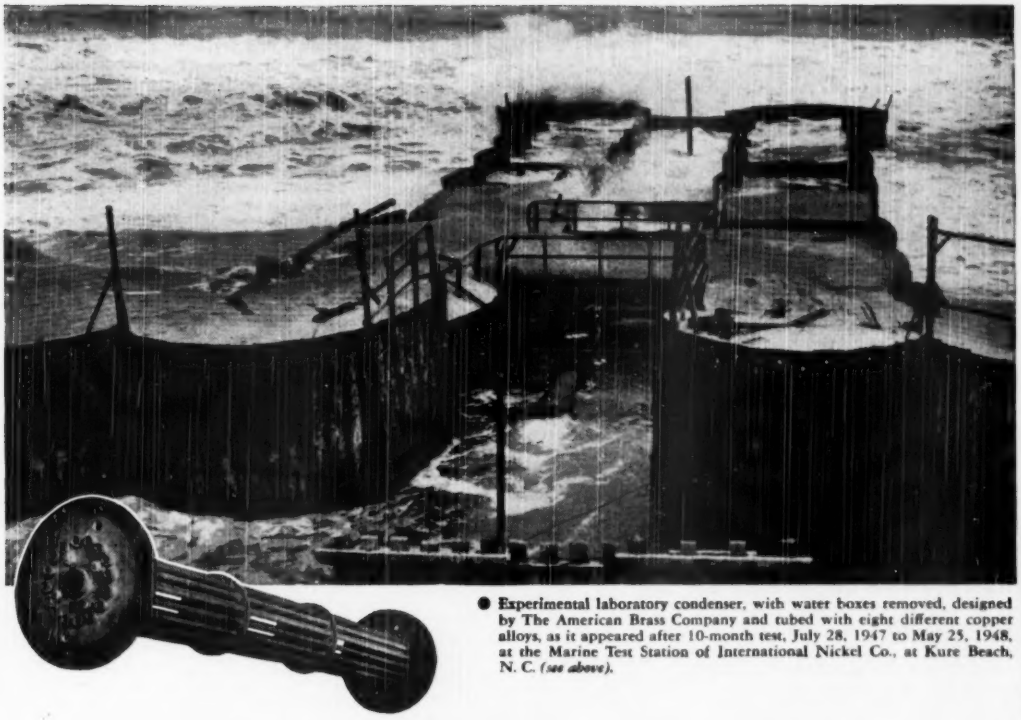
Impulse turbines include those of several jets and wheels. The specific speed per jet will not be constant because wheels that are mechanically suitable under 500 ft may not be under 1000 ft. According to their experience and manufacturing facilities, different builders will propose either horizontal units with two wheels and two jets per wheel, or vertical single-wheel units with three to six jets. High specific speed is obtained either by a relatively slow-speed wheel with five or six jets, or by a faster wheel with three or four jets supplied from the same nozzle ring.

Similarly, the francis units in the controversial region will not be identical although there will probably be less variation among francis designs than among impulse units.

The present state of the problem may be represented graphically by dividing Fig. 2 into three zones. In the upper, we would at present suggest only impulse wheels, in the lower zone, only francis wheels. In the intermediate zone we might suggest either impulse or francis wheels depending on the particular conditions of each installation and the relative importance of various factors that come into the question, particularly the abrasive properties of the silt carried by the water.

In the francis zone one could no doubt cite many existing impulse installations giving complete satisfaction. These would generally be old installations for which we would not recommend francis wheels except in special cases. The two curves of Fig. 2 show the present practice as represented by a number of recent installations. But if the factors that recommend the francis are numerous and varied, the factors in favor of impulse units are no less so. In the paper the problem is simplified by first comparing the respective merits of an impulse turbine and a francis turbine for a given head and power. These are considered under capital costs, reliability, efficiency, maintenance cost, cavitation, silt, influence of wear and other factors. *ASME Paper No. 49-A-111.*

HEAD AND FLOW OBSERVATIONS ON A HIGH-EFFICIENCY FREE CENTRIFUGAL PUMP IMPELLER, *by W C Osborne and D A Morelli, Hydraulic Machinery Laboratory, California Institute of Technology.* Studies of the flow through the



● Experimental laboratory condenser, with water boxes removed, designed by The American Brass Company and tubed with eight different copper alloys, as it appeared after 10-month test, July 28, 1947 to May 25, 1948, at the Marine Test Station of International Nickel Co., at Kure Beach, N. C. *(see above).*

ANACONDA Cupro-Nickel 754

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Shows High Resistance Under Accelerated Test

TEN months of testing with high velocity sea water at Kure Beach, N. C., demonstrate the superiority of Anaconda Cupro-Nickel 754 (nominal composition, copper 89.25 percent, nickel 10 percent, iron .75 percent) over a number of widely used condenser tube alloys.

The purpose of the test was to determine the resistance of various standard tube alloys to corrosion-erosion type of deterioration caused by turbulent flow of sea water. The tubes are .625" O. D., 18 gage (.049"), and 61 inches long. The average velocity of sea water flowing through the tubes, during the continuous 10-month test, was 11.7 feet per second. Water temperature varied from 45°F. to 85°F., according to the season of the year.

This test, and performance records where Cupro-Nickel 754 tubes have been in service under severe operating conditions, indicate that this tube and tube sheet alloy will give economical service for central station and marine condensers handling clean and some types of polluted sea waters. The American Brass Company welcomes opportunities to discuss problems relating to condenser tubes, and the services of its Technical Department are available for assistance in selecting alloys to meet specific operating conditions.

ANACONDA

Anaconda

CONDENSER TUBES

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut

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various parts of hydrodynamic machinery are in progress in the Hydraulic Machinery Laboratory of the California Institute of Technology. Observations have been made on an impeller patterned after the Grand Coulee design. The impeller was operated as an isolated unit, hydraulically free of the casing. Flow pattern at the discharge has been quantitatively determined for one flow rate and a head-capacity curve for the impeller has been obtained. This paper is a report on the findings up to the present time. *ASME Paper No. 49-A-108.*

Water Treatment

DEAERATING FEEDWATER HEATER PROBLEMS, *by E B Kuhn, Elliott Co.* Problems in selection of deaerating feedwater heating equipment are not involved but must represent logical thinking from the original planning to the actual operation of the unit.

The author outlines points of consideration in selection and purchasing of the equipment, and the mechanics of operation and servicing after it has been installed.

The discussion is not a technical one; it is presented to assist the engineer who has only an occasional contact with the subject. *ESWP paper. No number.*

DEAERATING HEATERS TRAY TYPE VS SPRAY TYPE, *by A L Jones, manager, deaerator and water-treating sections, Worthington Pump & Machinery Corp.* An unbiased discussion of the design and operation of the two types of deaerators as applied to stationary service is the basis of this paper.

Illustrations of the units are included, along with steam-pressure drop curves showing pressure loss through deaerating sections.

This paper is presented as an aid to those specifying, selecting or operating deaerating heaters and deaerators. Thus, knowing the basic principles in design and operating characteristics of the two types they may intelligently select the type better suited to their conditions. *ESWP paper. No number.*

OPERATIONS OF THE ION-EXCHANGE WATER-TREATING PLANT AT TEXAS CITY, *by A R Pettyjohn, Carbide and Carbon Chemicals Corp.* This paper is an account of experiences with ion-exchange water-treating materials: (1) with the controlled cation-exchange of well water (2) with the demineralization of a different, more highly mineralized well water (3) with sodium-exchange softening of clarified, filtered river water.

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from one of the following sources:

American Society of Mechanical Engineers, annual meeting, New York, N.Y., Nov 28-Dec 1, 1949. Papers are identified by initials ASME. Obtainable through ASME, 29 W 39th St, New York 18, N. Y.

Engineers Society of Western Pennsylvania, annual meeting, Pittsburgh, Pa., Oct 17-19, 1949. Papers are identified by initials ESWP. Obtainable in proceedings, at $7.50 from W M Porter, secretary, ESWP, William Penn Hotel, Pittsburgh, Pa.

These changes were made necessary in expanding the treating plant from a nominal capacity of 250 gpm to 2400 gpm—availability of water being the limiting factor.

The paper is practical, showing the capacities, regeneration chemicals, and performance of the different minerals and waters. Some operating "kinks" are reported. *ESWP paper. No number.*

HIDEOUT OF SODIUM PHOSPHATE IN HIGH-PRESSURE BOILERS, *by F G Straub, research professor of chemical engineering, University of Illinois.* A study has been made to explain a type of hideout of sodium phosphate in steam boilers operating at about 1700 psi. This has shown that an insoluble form of sodium phosphate is stable at temperatures above 620 F.

This type of phosphate is scale-forming, is resistant to heat transfer, and does not have the properties corresponding to those of the sodium phosphates normally encountered in steam-boiler water. Analysis by chemical means, X-rays and petrography all indicate this is a different form of sodium phosphate. Tests reveal that no insoluble potassium phosphate is formed and, if suitable potassium-to-sodium ratio is maintained, this insoluble salt will not form. *ASME paper No. 49-A-39.*

Dust Collection

CYCLONE DUST-COLLECTOR DESIGN, *by Melvin W Frost, Harvard School of Public Health.* Published reports on cyclone collectors have been characterized by a lack of agreement. Proposed formulas for predicting collection efficiency and power consumption have little application except to designs on which the investigator worked. In addition, there are serious differences in theories of the mechanism of separation and the course of a gas or solid through the apparatus.

The study this paper represents was undertaken to obtain more detailed information on flow pattern and dust distribution in operating cyclones. A systematic study of effects of change in significant cyclone proportions was made.

The author supplied numerous illustrations of test equipment as well as arrangements for various determinations. With data collected from these tests the following points are discussed: (1) influence of cyclone size (2) influence of entry width (3) influence of entry height (4) influence of exit-duct diameter (5) influence of cone height (6) influence of length of exit duct in the cyclone (7) influence of inlet vane. Further topics studied were energy loss and gas velocity in the cyclone as well as a check on dust-collection efficiency. *ASME paper No. 49-A-127.*

REDUCTION OF PRESSURE DROP ACROSS VORTEX DUST COLLECTORS, *by F B Schneider, Locomotive Engineering Div, General Electric Co.* The greatest disadvantage of vortex dust collectors is the large pressure drop caused by the whirling motion of the gas while performing the cleaning action. Even small reductions of pressure drop will provide substantial savings in power consumption.

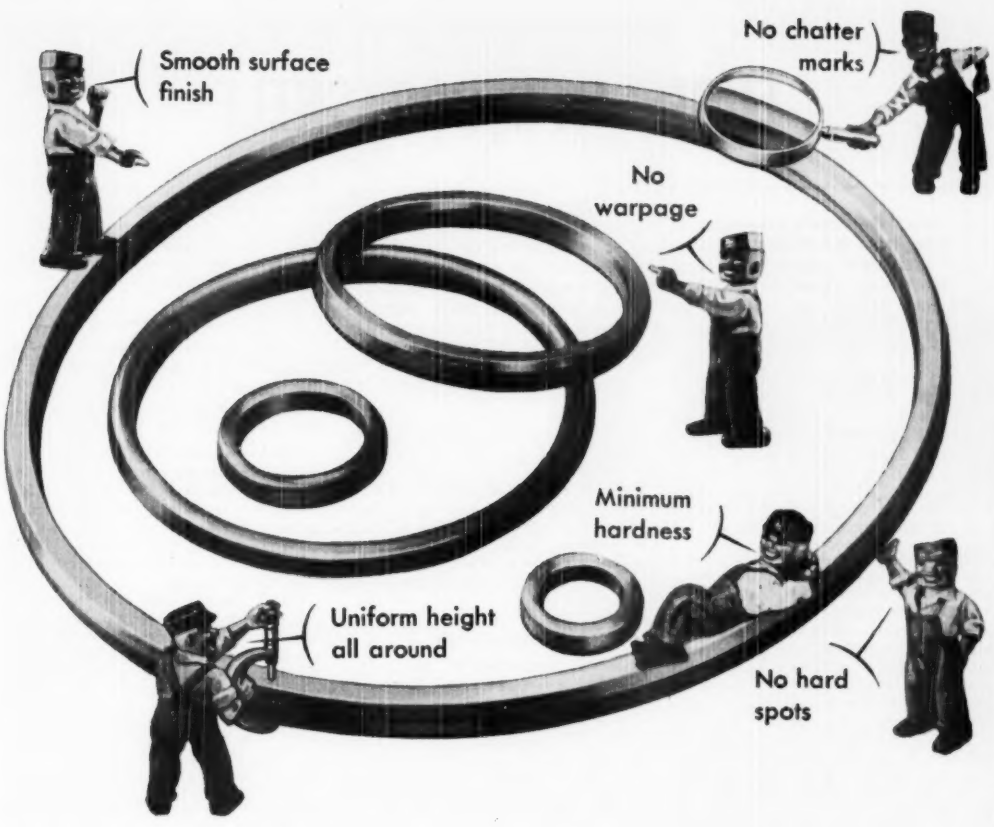
In attacking the problem of reducing high-pressure drop, care must be taken not to destroy the vortex in the long separator cylinder. This seriously affects dust-separating efficiency. To change the vortex to a flow of constant angular velocity decreases pressure drop considerably but the apparatus loses much of its value as a separator.

Generally the outlet of a collector consists of the rim of the inner cylinder, which leads to a reducer-fitting and an outlet pipe. Nothing is done to stop the spinning action of the gas before it enters the curved outlet pipe. Pressure drop runs high in this section.

One way to straighten out spinning flow into parallel flow is to let the discharge expand into a cylinder with a closed top. The spinning air spirals along the cylinder walls and discharges with straight parallel flow into a tangential outlet near the level of the central entrance.

The author set up a test vortex separator. On it were all the instruments needed for plotting pressure drops and air-flow patterns. Then the tests were analyzed. Calculations employed make up a considerable part of the paper. *ASME paper No. 49-A-126.*

(*Continued on page* 156)



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ENGINEER'S BOOKSHELF

REVIEWED IN THIS ISSUE

HEAT TRANSFER • STANDARDS OF TUBULAR EXCHANGER MFRS ASSN INDUSTRIAL ELECTRONICS • ANALYSIS AND LUBRICATION OF BEARINGS ELECTRICAL MACHINERY • SMOKE PREVENTION ASSN OF AMERICA ELECTRICAL ESTIMATING • ENGINEERS' DICTIONARY: SPANISH-ENGLISH MACHINE DESIGN AND CONSTRUCTION (Ger) • REWINDING SMALL MOTORS GAS-TRANSPORTATION SYSTEM CALCULATIONS • MESSAGE FOR GREATNESS INDUSTRIAL ELECTRONIC CONTROL • ELECTRICAL ENGINEERS' HANDBOOK

Electrical Machinery

ELECTRICAL MACHINERY *(3rd edition, 1950). By F A Annett, associate editor, Power,* 458 *pp,* 6x9, 525 *illust, cloth.* $3.75. *McGraw-Hill Book Co,* 330 *W 42nd St, New York* 18, *N. Y.*

Home students and those attending short courses find that many features in electricity develop into stumbling blocks. They get wrong conceptions of theory, or find it difficult to grasp elementary laws of electricity and magnetism. To guide the student over these pitfalls the author uses problems dealing with conditions that practical men come in daily contact with. He shows how theory fits into practice.

This edition brings up to date magnetism, electricity, ohms law, instruments, generators and motors. Addition of 54 pages on industrial electronics is divided into four chapters that treat: (1) the electron: a tool that does many useful things: how it does them. (2) electron-tube rectifiers (3) electronic motor control (4) smoke indicators and flame-failure protection. These are among the applications that power engineers come in contact with most often.

In electronic equipment, there are explanations of how each piece works rather than dealing with their parts and leaving the reader to fit them together.

Heat Transfer

HEAT TRANSFER, *Vol. I. By Max Jacob, research professor of mechanical engineering Illinois Institute of Technology.* 758 *pp, illust, tables,* 6x9. $12. *John Wiley & Sons, Inc,* 440 *Fourth Ave, New York* 16, *N. Y.*

In contrast to most works on heat transfer this book does not deal with convection, conduction and radiation as three separate parts. By parallel treatment these three methods of transfer have their peculiarities and interrelations more clearly stressed. The first part of the book contains the basic equations of all three methods. The second part deals with the most characteristic properties occurring in each method. After this the equation solutions for the three methods are separated in the conventional manner. Each of these parts contains straight solutions, similarity treatments, graphical and experimental methods and so on.

Combination of the different methods for various practical applications and a section on radiation will be given in a second volume. A middle road was chosen between methods of presentation using a highly mathematical approach or that of giving just empirical facts. This will help the book serve the needs of mechanical, chemical, electrical and civil engineers as well as physicists.

Electrical Estimating

ELECTRICAL ESTIMATING. *By Ray Ashley, research engineer, Electrical Contractors Assn, City of Chicago,* 312 *pp,* 10x7½ *in.,* $6.50, *McGraw-Hill Book Co,* 330 *W 42nd St, New York* 18, *N.Y.*

Information needed to estimate cost of electrical construction. Book is packed with practical methods, tips and guide to help streamline estimating procedure. There are scores of sample estimates of actual construction costs.

Reflecting 25 years' experience in the electrical-contracting industry, the book covers a range from selection and training of electrical estimators and proper use of estimating tools to cost of preliminary estimates and preparation of final bid sheets.

Electronics

INDUSTRIAL ELECTRONICS (1949). *By Andrew W Kramer, editor, "Power Generation."* 311 *pp,* 6x9 *in., illust, cloth.* $6. *Pitman Publishing Corp,* 2 *W 45th St, New York* 19, *N. Y.*

Like the electronic industry, books on industrial electronics are coming fast. Here is another good one on elementary principles and applications. It is primarily for those who have a knowledge of general physics and engineering, but who have very little training or experience in electronics.

More than half the book is devoted to basic principles. This section includes electron behavior, electron-tube principles, triode characteristics and operation, electron generation of electrical oscillations, multi-element tubes, gas-filled tubes, mercury-pool tubes, photoelectric tubes and cold-cathode tubes. Latter part of the book deals with electronic applications. These are grouped under such general headings as control and regulation, instrumentation, production of light and production of heat. For practical men in industrial plants who want to know how electronic apparatus works, how to apply and maintain such equipment, this book supplies the necessary information in easily understood terms.

Gas Transportation

GAS-TRANSPORTATION SYSTEM CALCULATIONS (1949). *By Benjamin Miller, consulting engineer, Ozone Park, N. Y.* 226 *pp,* 8½x11 *in.,* $7.50. *Moore Publishing Co, Inc,* 9 *E 38th St, New York* 16, *N. Y.*

With a few slight changes and additions, this book is based on a series of 40 articles that appeared during 1947-48 in *Gas Age.* While written primarily for engineers engaged in design of gas-transportation systems, it deals in a basic way with problems of flow and compression common to many types of engineering.

Initial chapters deal with flow fundamentals and problems of pipelines. Additional material covers the specification, inspection and testing of pipe for gas lines. Another group of 16 chapters discusses the compression of gases, while the last six are devoted to the economics of gas transportation.

Electrical Handbook

ELECTRICAL ENGINEERS' HANDBOOK (*Electric Power*), *4th edition. Edited by Harold Pender and William A Del Mar,* 1520 *pp,* 8½x6 *in.,* $8.50. *John Wiley and Sons Inc,* 440 *Fourth Ave, New York* 16, *N.Y.*

Seventy-one specialists in their respective fields have contributed to this fourth and entirely rewritten edition. Book is divided into 19 sections running the gauntlet from basic mathematics to rural-electrification distribution systems.

Among the subjects covered are dc and ac machines, transformers, power rectifiers and inverters, switchgear and control equipment, power stations and substations, power transmission and distribution, lighting and heating and industrial applications of motors and servomechanisms.

Spanish Dictionary

ENGINEERS' DICTIONARY — *Spanish-English and English-Spanish (2nd ed,* 1949). *By Louis A Robb.* 664 *pp,* 5½x8½ *in., semi-flexible binding,* $12.50. *John Wiley & Sons,* 440 *Fourth Ave, New York* 16, *N. Y.*

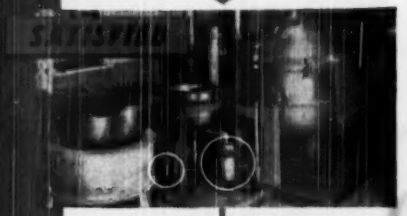
First edition represented a pioneering effort, which dealt thoroughly with civil-engineering terms but could not go so far in other fields. This new edition has been greatly enlarged to cover electrical and mechanical engineering more completely.

To keep down bulk and to make the book's use more convenient, definitions are not included. It lists Spanish equivalents

(Continued on page 164)

"This Steam Trap is unconditionally guaranteed to satisfy you!"

YOU CAN'T LOSE



SAVED 3728 GALLONS OF FUEL OIL in one year after replacing old traps with Armstrongs on kettles, low pressure heating system and cream beaters.—*Mary Lincoln Candies, Buffalo, New York.*

30% LESS MAINTENANCE with Armstrong traps on heating and steam distribution system.—*John Deere Harvester Works, East Moline, Ill.*

COOKING KETTLE OUTPUT SPEEDED UP 30% by Armstrong trapping on each steam jacketed kettle.—*Bulman's Ltd., Vernon, B. C.*

EVERY Armstrong steam trap is guaranteed to be free from defective workmanship or material, to function perfectly, to fulfill all claims in every respect and to give complete satisfaction.

ONLY A GOOD STEAM TRAP COULD *POSSIBLY* BE BACKED BY SUCH A GUARANTEE! To save fuel, to reduce maintenance, to get more work out of existing equipment, to get complete steam trap satisfaction, ask your nearby Armstrong representative to discuss with you the traps you need now.

ARMSTRONG MACHINE WORKS
812 Maple St., Three Rivers, Mich.

SEND FOR YOUR COPY OF THE 36-PAGE ARMSTRONG STEAM TRAP BOOK explaining the design and workmanship that make the Armstrong guarantee possible. Complete data on the selection and installation of traps for all classes of equipment. Free on request.

ARMSTRONG STEAM TRAPS

POWER NEWS

BUSINESS ITEMS • APPOINTMENTS • FOREIGN FIELDS
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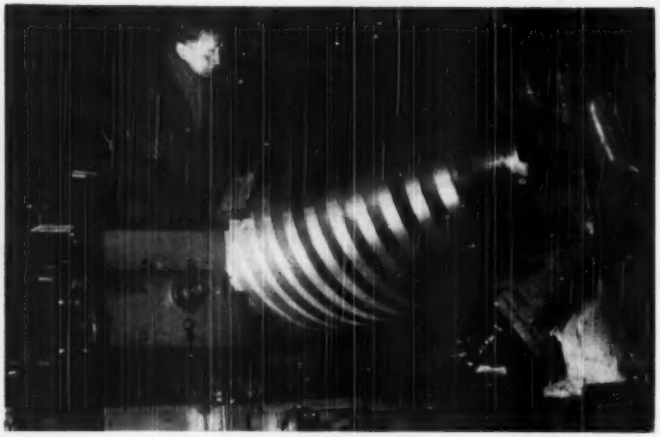

British Information Services

Closed Cycle Gas Turbine May Burn Peat

What is expected to be the first gas turbine to operate in normal power-station service in Great Britain is now under construction in the Clyde Bank works of Messrs John Brown, Ltd. Photo shows machining of low-pressure turbine rotor. The plant, rated at 12,500 kw, is of closed-cycle design (see POWER, Aug 1949, pp 95-97). To be installed in the Carolina Port Station of the North Scotland Hydro-Electricity Board, it will back up new hydro facilities, handling peak loads when water supply is high and base loads when it is low. While the unit will burn heavy fuel oil initially, it will later handle pulverized coal and peat. Trials with peat will be part of the Peat Utilization Committee work seeking commercial uses

COMING EVENTS

April 4-7—National Assn of Corrosion Engineers, Jefferson Hotel, St. Louis, Mo.; A B Campbell, exec sec, 919 Milam Bldg, Houston 2, Texas.

April 5-7—Midwest Power Conference, Sherman Hotel, Chicago, Ill.; Dr R E Whitehead, secy, Illinois Institute of Technology, 3300 S Federal St, Chicago 16, Ill.

April 10-12—American Society of Lubrication Engineers, Detroit, Mich.; W F Leonard, secy, ASLE, 343 S Dearborn St, Chicago 4, Ill.

April 12-14—American Society of Mechanical Engineers, spring meeting, Statler Hotel, Washington, D. C.; O B Schier, ASME, 29 W 39th St, New York 18, N. Y.

April 19-20—American Institute of Electrical Engineers, Power Conference, Wm Penn Hotel, Pittsburgh, Pa. R S Gardner, AIEE, 29 West 39th St, New York 18, N. Y.

May 21-25 — Smoke Prevention Assn of America, Mount Royal Hotel, Montreal, Can.

May 23-26—National District Heating Assn, annual meeting, Grove Park Inn, Asheville, N. C. John F Collins, Jr, secy-treas, 827 N Euclid Ave, Pittsburgh 6, Pa.

Puerto Rico Enlarges Power Capacity

► McGraw-Hill World News—Puerto Rico Water Resources Authority, government-owned public utility, has put under construction a $14,000,000 power project at Puerto Nuevo, near San Juan, which will produce one of the largest steam power plants in Latin America.

By January 1951, it is hoped to have two of the proposed three 20,000-kw turbine-generators completed. The entire plant is designed for as little manual operation as possible. It features a centralized operating bay between boilers and turbine-generators. The operator is within easy reach of turbine, boiler, main feed pumps and electrical switchgear controls.

Ultimately the plant will house five 20,000-kw turbine-generators. Five oil-fired 200,000-lb-per-hr 900-psi 850-F steam generators will carry the load. Boilers and auxiliaries, such as forced- and induced-draft fans, air preheaters, etc, will be installed outdoors. All the outdoor-mounted equipment must be designed to withstand wind velocities up to 150 mph.

Each boiler will be equipped with four mechanical atomizing oil burners. Combustion control, as mentioned above, is as completely automatic as possible. Constant differential pressure valves will control the fuel feed. Forced draft fans will be arranged to operate in parallel with the fuel feed. Each boiler will have air-operated automatic soot blowers.

Fresh water from city mains will be stored in two 50,000-gal tanks for both station service and makeup water evaporators. A salt-water evaporator has been provided for use in extreme water shortage emergencies.

Cooling water for the turbine-generator condensers will be supplied by 2-speed reversible propeller-type circulating-water pumps of 20,000-gpm capacity at high speed, and 10,000-gpm at low speed. There are duplex intake and discharge canals to prevent shutdown from plugged-up condenser tubes.

A separate cooling-water system serves the generator hydrogen coolers, turbine oil coolers, bearing coolers and air-compressor jackets. This is a closed system operated by means of three circulating pumps and three induced-draft cooling towers.

Raymond Concrete Pile Co of South America are contractors for the construction of the bulkhead and wharf, power plant building, condenser circulating water canals and the foundations of the major equipment. Jackson and

(*Continued on page* 198)

From routine water treatment reports and water sample analyses, experts at Nalco Laboratories keep a complete record of your plant water treatment — can assist materially in maintaining permanent water treatment security.

How a *Nalco* WATER TREATMENT SERVICE AGREEMENT WORKS FOR YOU

OPERATION of your plant under a Nalco Water Treatment Service Agreement gives you two important safeguards against water treating problems in any form. First, Nalco will provide proper water treatment chemicals and procedures. Second, an experienced Nalco Service Representative will make regular visits to your plant, and is on call at any time to deal promptly with emergencies. Whether you have 10 or 10,000 BHP, this combination will provide what thousands of Nalco System users have learned to take for granted: *permanent water treatment security.*

Write, now, for full information on a Nalco Service Agreement for your plant.

Nalco

SERVICE AGREEMENT SECURITY FEATURES

- **COMPLETE WATER TREATMENT SURVEY** of your plant by an experienced Nalco representative.
- **LABORATORY ANALYSES** of water samples . . . Initial complete analyses, followed by routine sampling and analyses as checks on plant tests.
- **RECOMMENDATIONS** of chemicals, testing and control procedures to establish water treatment security.
- **REGULAR CALLS** by a Nalco Representative to assure continuously successful treatment.
- **REPORT SYSTEM** to Nalco Laboratories gives cross-check on all phases of the Nalco System; enables keeping of complete performance records on your plant.
- **CONSULTING SERVICE** always available to assist in solving current problems — and in planning changes or additions to your plant which may affect water treatment.

NATIONAL ALUMINATE CORPORATION

6222 West 66th Place • Chicago 38, Illinois

Canadian inquiries should be addressed to Alchem, Limited, Burlington, Ontario, Canada

THE *Nalco* SYSTEM • Serving Industry through Practical Applied Science

JENKINS PRACTICAL PIPING LAYOUTS 51

How to plan a

STORAGE AND VAPORIZER HOOKUP FOR LIQUEFIED PETROLEUM GAS

One of the newest industrial and domestic fuels, Liquefied Petroleum Gas (such as propane, butane) is liquefied at atmospheric temperatures by the application of moderate pressures. It is then shipped by tank car to central storage plants in areas where it will be consumed. Diagram shows piping and other equipment used in vaporizing and storing these gases.

Unloading the liquefied gas into storage tanks is facilitated by a liquid pump and vapor compressor. The compressor draws off the vapor from the tank and returns it to the tank car at a slightly higher pressure, which helps force out the remaining liquid. The liquid passes through a regulating valve, then through the vaporizer where heat, from either steam or hot water, converts it to vapor at the required rate.

This gaseous fuel is then piped through a pressure regulator which assures a constant pressure, and on to the gas distribution system or to a gas-air mix unit if required. Vaporizers are installed in duplicate to provide continuous service in case of breakdown. Safety relief valves are vented to the atmosphere. The check valve recommended on the inlet end of the vaporizer acts as a relief valve when a higher pressure is reached in the vaporizer than in the storage tank.

Globe valves on pressure lines are the new Jenkins Bronze Globe Fig. 306, designed specifically for Liquefied Petroleum Gas service. This valve is fitted with Jenkins slip-on stay-on disc holder and a 930-A disc, particularly recommended for L.P.G. service. The crowned seat assures absolute tight closure with a minimum of closing effort. Lugs on the body ends permit a firm grip with wrench for repeated valve disassemblies and assemblies without damage.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installations.

A CHOICE OF OVER 500 VALVES

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering experience, select all the valves you need from the Jenkins Catalog. *It's your best assurance of lowest cost in the long run.*

Reserve your copy of
NEW BOOK of PIPING LAYOUTS — NOS. 26 to 50

A new book of Jenkins Practical Piping Layouts—Nos. 26 to 50—is in preparation. Mail coupon to get your copy when ready.

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San Francisco. Jenkins Bros., Ltd., Montreal.

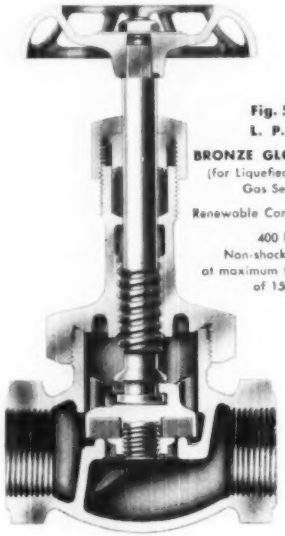

Fig. 306
L. P. G.
BRONZE GLOBE VALVE
(for Liquefied Petroleum Gas Service)
Renewable Composition Disc
400 lbs.
Non-shock O.W.G.
at maximum temperatures of 150°F.

JENKINS BROS., 80 White St., New York 13, N. Y.
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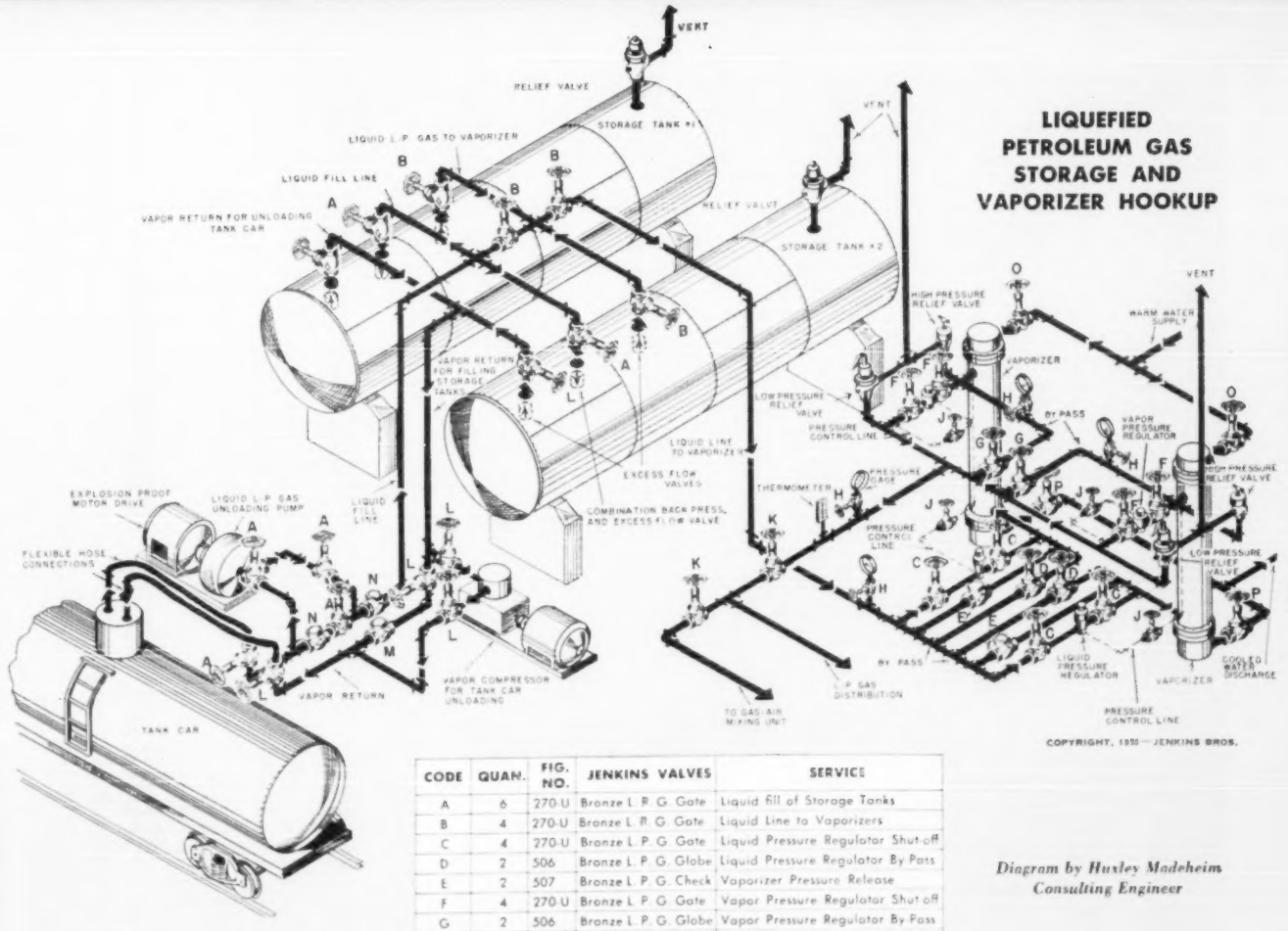
Illustrating the proved 3-point formula for trouble-free, time-defying hookups

1. **Use the right type valve for the service**
2. **Place valves correctly in the line**
3. **Choose Jenkins Valves for lifetime economy**

JENKINS VALVES

LOOK FOR THE DIAMOND MARK

LIQUEFIED PETROLEUM GAS STORAGE AND VAPORIZER HOOKUP



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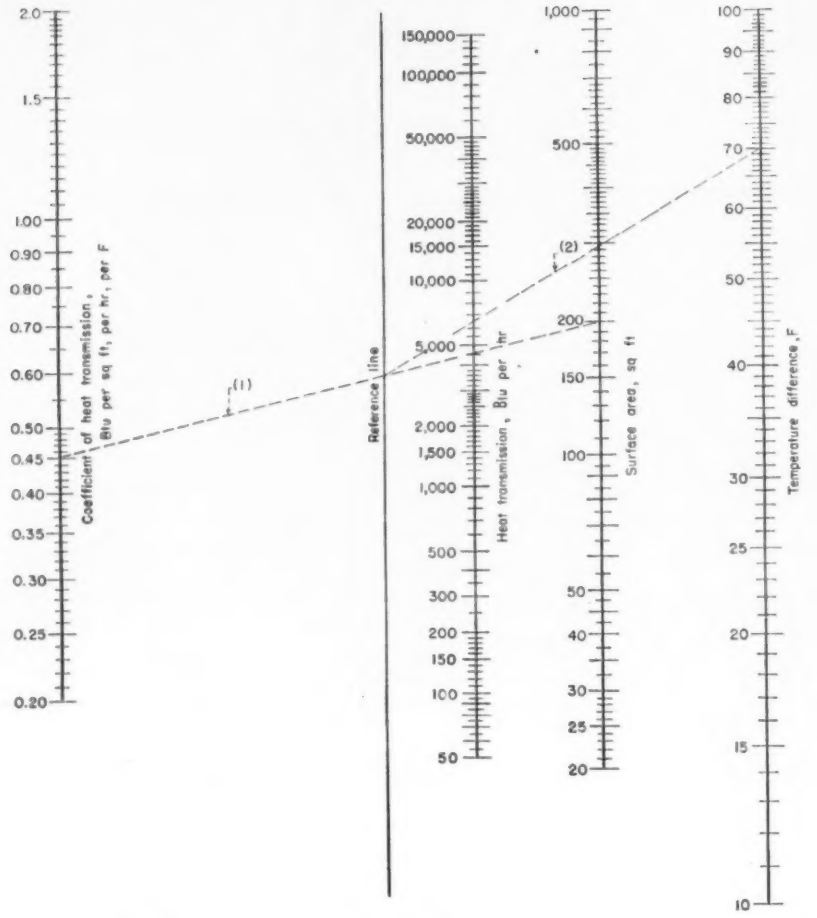
CODE	QUAN.	FIG. NO.	JENKINS VALVES	SERVICE
A	6	270-U	Bronze L. P. G. Gate	Liquid fill of Storage Tanks
B	4	270-U	Bronze L. P. G. Gate	Liquid Line to Vaporizers
C	4	270-U	Bronze L. P. G. Gate	Liquid Pressure Regulator Shut-off
D	2	506	Bronze L. P. G. Globe	Liquid Pressure Regulator By Pass
E	2	507	Bronze L. P. G. Check	Vaporizer Pressure Release
F	4	270-U	Bronze L. P. G. Gate	Vapor Pressure Regulator Shut-off
G	2	506	Bronze L. P. G. Globe	Vapor Pressure Regulator By Pass
H	4	506	Bronze L. P. G. Globe	Pressure Gage Control
J	4	506	Bronze L. P. G. Globe	Pressure Control Line Shut-off
K	2	270-U	Bronze L. P. G. Gate	Distribution System Shut-off
L	6	270-U	Bronze L. P. G. Gate	Vapor Return for Tank Car
M	1	507	Bronze L. P. G. Check	Prevent Vapor Backflow
N	2	507	Bronze L. P. G. Check	Prevent Liquid Backflow
O	2	47	Bronze Gate	Warm Water Supply
P	2	106-A	Bronze Globe	Cool Water Discharge

VALVE RECOMMENDATIONS
For details and valves to suit varying conditions see Jenkins Catalog

Diagram by Huxley Madeheim
Consulting Engineer

Number 213



Building Heat Transmission

► HEAT LOSSES OR GAINS through building surfaces are found from:

$q = UA\Delta t$ where

q = heat transmitted, Btu per hr

U = over-all coefficient of heat transmission for wall, floor or ceiling, Btu per sq ft per hr per degree F

A = surface area, square feet

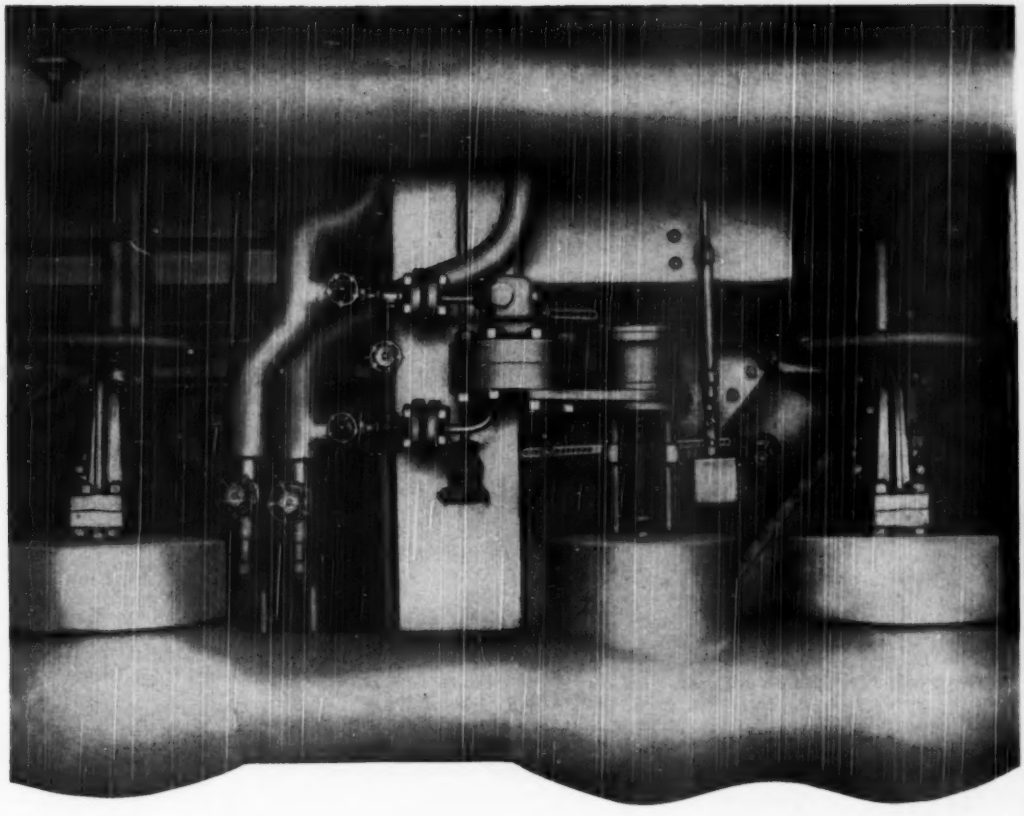
Δt = temperature difference across surfaces, F

While calculation of the formula is rather simple, the nomogram will be useful where a large number of calculations must be made.

Example: How much heat will pass through 200 sq ft of wall with a heat-transmission coefficient of 0.45 and a total temperature difference of 70 F?

Connect the values of coefficient and area on first and third scale by a straightedge to find intersection with reference line. From here, connect with straightedge to temperature-difference scale at right, and read 6300 Btu per hr, at intersection with second scale.

TYLER G HICKS *Summit, N. Y.*



How to hold boiler water level closely

When you want to hold boiler water level within close limits, no matter how widely or rapidly loads change, depend on COPES Flowmatic—the simplest, most widely used flow-level type of feed control.

This industrial installation, for example, is on a 660-psi Riley Steam Generator rated at 225,000 pounds per hour. Loads constantly fluctuate 10,000 pounds per hour over a total range from 150,000 to 265,000 pounds per hour. Yet water level is held within plus-or-minus one inch at all times.

More than 1200 Flowmatic users like the coordination of influences from steam flow and water level to get the exact feed needed for close level control. They also like the ease with which plant personnel can handle all maintenance.

For a complete performance report on installation illustrated above, write for Bulletin 485.

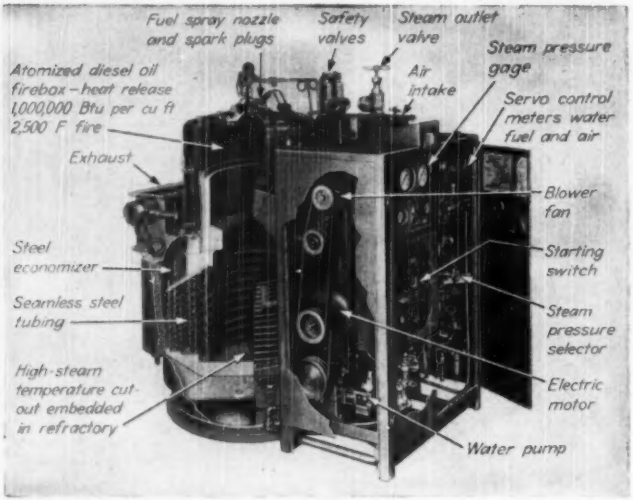
NORTHERN EQUIPMENT CO.
301 Grove Drive, Erie, Pa.
BRANCH PLANTS: Canada, England, France, Austria, Italy. *Representatives Everywhere*

COPES
Headquarters for . . .
Boiler Feed Water Control . . . Excess or Constant Pressure Control, Steam or Water . . . Liquid Level Control . . . Balanced Valves . . . Desuperheaters . . . Boiler Steam Temperature Control . . . Hi-Low Water Alarms.

PLANT EQUIPMENT NEWS

Published monthly as a service to readers

Your information center for new products to solve plant problems. Spot what you need, use handy cards to request more details



FULL WORKING PRESSURES are developed in less than two minutes with series of sizes that give from 75- to 600-psi steam at rates from 310 to 15,500 lb per hr

HERE'S A NEW QUICK-STEAMER

P 301 • Over 500 ft of patented steel coils surround the furnace chamber of the vapor steam generator, photo above. In this model, the OK-2500, slightly over 7-gal-of-water-per-min flow through the coils at a thermal efficiency of 80 to 83% delivering 99%-quality dry steam. Designs can give steam from 75 to 600 psi in capacities from 310 to over 15,500 lb per hr for sustained working periods of time.

Water from a supply tank passes through a 4-outlet water-strainer manifold under the pull of a pump. Two outlets on the manifold provide connection points for a water-relief valve and a water pump-test valve. A third outlet leads to a manual bypass valve and a fourth to a *servofuel* control by regulating amount of water bypassed back to the suction side of the pump. The steam-line pressure operates the control. Should the bypass regulator fail the manual control is used.

Fuel to the spray nozzle and combustion air to the firepot enter in a proportion determined by the feedwater flow rate. Heat release in the furnace chamber approaches 1,000,000 Btu per cu ft with diesel oil No. 3 as fuel. Gas can also be used. Hot gas from the combustion chamber scrubs the 500 ft of water and steam-carrying coil.

Steam leaving the coil goes first through a temperature-limit control, and then continues through a steam separator. All excess water and sludge are removed here. A separator blowdown valve takes off any collected sediment. Once out of the separator, the steam is piped to whatever uses are desired.

Power for blower, water pump, fuel pump and spark may be supplied by outside source, such as gasoline engine or portable generator equipment.

Descaling the steam generator requires circulating a 25% solution of inhibited muriatic acid through the coils, using an impeller or piston-type pump followed by a water rinse and blowing-down with steam. All this takes only about two hours.

Vapor Heating Corp, Railway Exchange, Chicago 4, Ill.

SPLASHPROOF MOTOR **P327**

Designed to take direct streams of water or other liquids, motor may be mounted in any position and keep its splashproof features. End bells permit free passage of air through baffles yet prevent splashing liquids from reaching motor interior. Air is drawn through rear of motor and exhausted from shaft end, thereby blowing away foreign materials. Sealed shaft ends assure protection against entry of liquids into bearing housings. All bearings are lubricated for life.

Sterling Electric Motors, Los Angeles 22, Calif.

GAS BOOSTER **P317**

New product features special gas exhausters fitted on the drive side with a gas-tight high-speed oil-lubricated rotary seal through which the drive shaft connects to the impeller.

Inlet and outlet are cut with standard pipe threads; a gas-tight connection. Approved compression-type couplings can be had at additional cost. Booster is built to allow gas flow through the unit when booster is not operating.

U.S. Air Conditioning Corp, 3377 Como Ave, SE, Minneapolis 14, Minn.

WATER-HAMMER ABSORBER P358

The industrial, dual and super pipeline shock absorbers are suitable for general industrial use, in public and commercial buildings, dairies, laundries, etc, to eliminate shock and water hammer in pipelines or other hydraulic systems.

Device consists of a rubber cushion encased in a spherical metal chamber, which pulsates constantly according to pressure variation in the systems. Can be installed in any position.

R-S Products Corp, Wayne Junction, Philadelphia 44, Pa.

COOLANT PUMPS **P319**

Driving mechanism is an enclosing housing that supports a pair of hardened-steel bevel gears. These gears have their vertical and horizontal shafts supported in ball bearings. Housing includes an automatic lubrication system supplied by a small centrifugal pump. Driven from the vertical gear shaft this pump forces a small stream of oil onto the gears.

Pumps are V-belt driven and have 10-gpm capacity at 4-ft head and 500-rpm sheave speed. At the same head and 1200 rpm, sheave-speed pump capacity jumps

For further data on above items use reply cards on page 190a, identifying your request with letter *P* and number

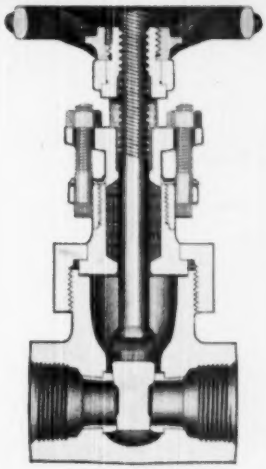
All the piping equipment you need ...on one order to CRANE

SMALL STEEL VALVES WITH BIG VALVE FEATURES

Crane 600-Pound Small Steel Gates with Union Bonnet—for steam, water, gas, or air—are smaller, lighter, and more compact than usual high pressure design . . . yet are amply strong. Metal sections at all points provide extra strength and safety under rough usage and extreme pressure-temperature conditions.

Body, bonnet and yoke are high quality carbon steel. Seating is Hardened Stainless to Exelloy, offering superior resistance to wear, corrosion, and temperature effects. Husky bonnet ring with long, precision-cut threads pulls up easily . . . always stays tight. Long-lived blowout-proof gasket in bonnet joint is unaffected by highest temperatures or fluids on recommended services. For more information, **write for circular AD-1741.**

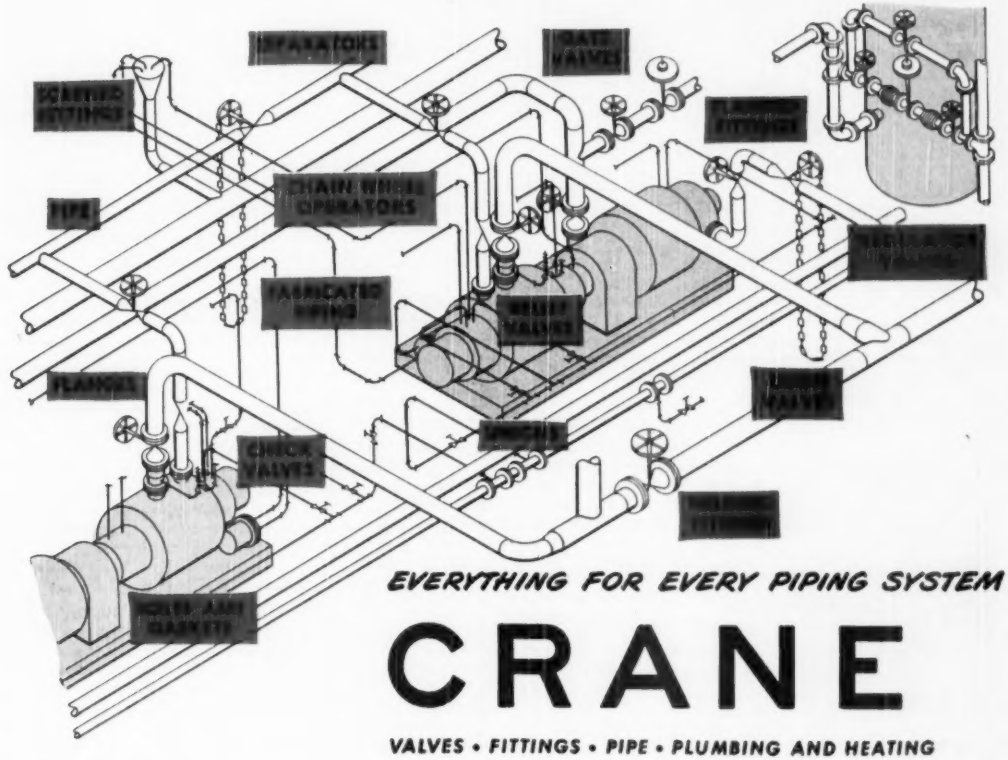
CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas



No. 3602XW

For steam up to 850 deg. F., and for water, gas, or air. Sizes: ¼ to 2 in. Screwed or welding ends

THIS POWER PLANT INSTALLATION, FOR EXAMPLE, CAN BE COMPLETELY EQUIPPED BY CRANE



EVERYTHING FOR EVERY PIPING SYSTEM

CRANE

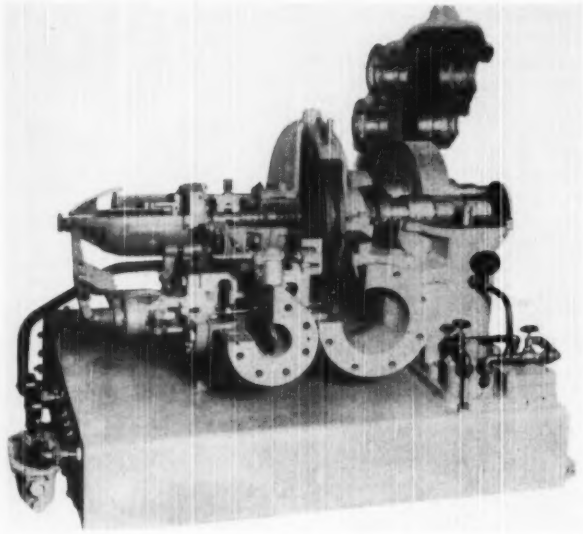
VALVES • FITTINGS • PIPE • PLUMBING AND HEATING

EQUIPMENT NEWS *CONTINUED*

to 44 gpm. Several standard-sized sheaves are available for "A" size V-belts. Pulleys, 3, 5 and 7 in. in diameter, can also be supplied.
The Ruthman Machinery Co, Cincinnati 2, Ohio.

SPRAY GUN **P348**

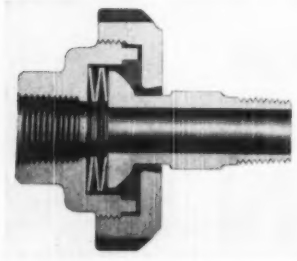
Extension spray guns come in three models: EX-T, TO and AE-46. Model EX-T features 4-finger trigger control, which provides easy off-and-on operation. Model TO is the simplest and lightest extension, and has separate shutoff cocks to control fluid and air.
Eclipse Air Brush Co, 390 Park Ave, Newark 7, N. J.



INDUSTRIAL TURBINE **P341**

Type E industrial steam turbine with close-coupled integral reduction gears for low-speed drive of pumps, fans and compressors, drives the load and allows the unit to run at its most efficient speeds. These new units combine a compact speed reducer solidly coupled to the turbine. Three machined feet give 3-point support. Single helical gears with low helix angle give low thrust against bearings.

Endwise movement of one shaft does not affect axial position of the other. Thrust is not transferred from gears to turbine. Turbine and gear are aligned on a single heavy plate-steel base that also serves as an oil tank. The *Gearturbine* is shipped as a completely assembled unit ready to install. These units are available with standard gear-reduction ratios.
Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.



SWIVEL JOINT **P305**

Little turning torque need be applied to new rotary swivel pipe joint because wedge action has been largely eliminated.

Joint performs without leakage at high temperatures; extra heavy models are available for extreme pressure and vacuums. Successful performance has been obtained at continuous rotation up to 30 rpm. Available in 90-deg angle and straight designs in ⅜- and 1-in. pipe sizes.
Barco Mfg Co, Dept 109, 1801 West Winnemac, Chicago 40, Ill.

(Continued on page 148)

Don't Miss...

. . . **Boiler Feed Pump** that combines primary and secondary pumps in a single unit. This reduces installation space 30 to 50%, along with cutting first cost. On top of that, it eliminates one drive, set of bearings and stuffing boxes ..... page 174

. . . **Air Filter Refill.** Comes in reusable frame for all types of forced air-heating, ventilating and air-conditioning systems ..... page 176

. . . **Portable Air Compressor** having a 500-cfm capacity using a diesel-engine drive starting as a gas engine ..... page 176

. . . **Alemite Caps** to fit over lubrication fittings where equipment is in dirty locations. Its job is to keep fitting clean ..... page 178

. . . **Manometer** good for line pressures up to 200 psi, available in scale lengths from 12 to 16 in. ..... page 178

. . . **Variable-Speed Unit** consisting of control section where incoming ac is rectified to dc, control station, and a ¾, 1, 1½ or 2 hp dc motor ..... page 180

. . . **Respirator** with twin cartridges. When unit is equipped with the proper filters it will protect operator against 7 types of irritants ranging from dust to metal fumes ..... page 182

. . . **Shock Absorber** that eliminates shock and hammering in pipelines and liquid systems. A rubber cushion encased in a spherical metal chamber absorbs the shock ..... page 182

. . . **Automatic Oiler** for slat conveyors. Oil valve opens when tripping mechanism is flipped by wheels outside conveyor. It then remains open until closed by timer ..... page 184

. . . **Motor Control Center** housing motor starters for centralized control of machine groups. Unit features plug-in disconnects on line side. Provision for venting hot ionized gases ..... page 186

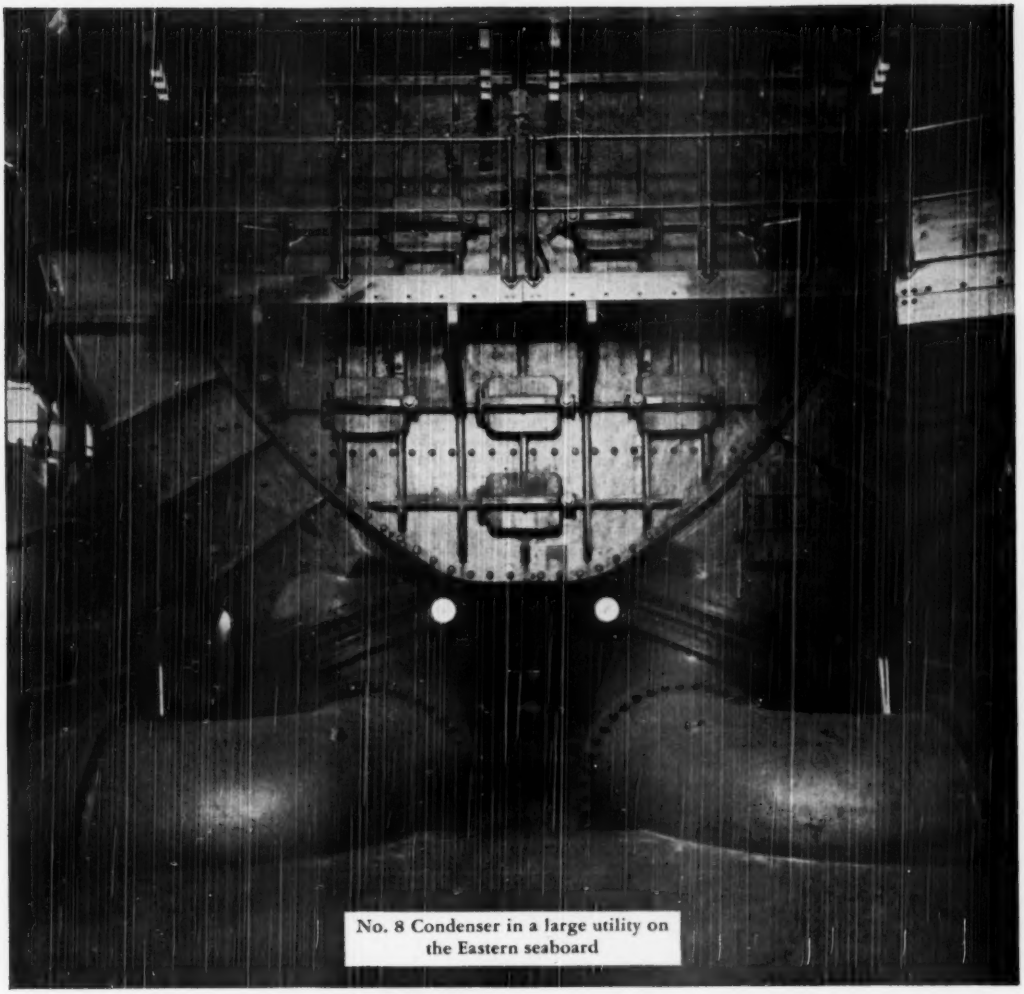
. . . **Oxyacetylene Outfit** for welding and cutting. Package contains both oxygen and acetylene cylinders, welding torch, cutting attachment, tips and welding rods ..... page 188

. . . **Tap Changer** designed for operation with loaded transformer. Arcing duty is eliminated from the tap selector switch ..... page 190

And Next Month...

. . . **Voice of Safety** allows the plant safety man to deliver his recorded message at the point of danger before the danger moment. Recording may be started by interception of light beam or otherwise.

For further data on above items use reply cards on page 190a, identifying your request with letter *P* and number



No. 8 Condenser in a large utility on the Eastern seaboard

don't let FOULING get your figures ALL FOULED UP!

● One important factor taken into account when figuring on the heat-transfer capacity of a condenser is fouling. But the effect of the tube alloy on both rate and amount of fouling is sometimes ignored in design calculations. The acceptance test of a condenser is made with clean tubes. However, the average heat transfer rate varies with time, and fouling is the chief factor in such variation. In many applications this indicates the need for serious consideration of cupro-nickel tubes, which are recognized to have superior anti-fouling characteristics, as well as high resistance to corrosion, erosion, impingement. Thus it can be said that cupro-nickel, 30%, will provide more uniform transfer rates over a period of time, require cleaning much less often, and last longer . . . Revere makes condenser tubes in cupro-nickel as well as in all the other customary copper alloys. We will gladly collaborate with you in a study of the economics of condenser tube selection to meet your needs for true economy. Write for reprint of article entitled "What Factors Should You Consider in Selecting Condenser-Tube Alloys?"

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, NewYork 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere.

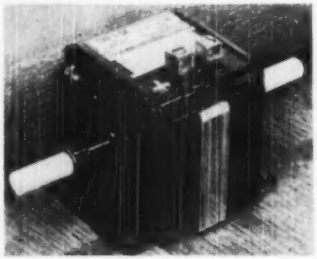
MIXED-BED ION EXCHANGER P359

Water containing less than one part of ionic solids per 100 million parts of water can be produced by passing water through a mixed bed of *Amberlite* resin. Permits complete removal of inorganic salts without deviation from a pH of 7.0.

Advantages of the mixed bed process are: (1) reduced cost of both equipment and regeneration; (2) lower rinse requirements; (3) uniform performance in intermittent service; and (4) sharp breakthrough at depletion of the bed.

Effluent is the equivalent in ionic purity to triple distilled water. The one-bed unit contains an intimate mixture of *Amberlite IRA-400* (hydroxyl form) and *Amberlite IR-120* (hydrogen form) resins.

Resinous Products Div, Rohm & Haas Co, 222 W. Washington Sq, Philadelphia 5, Pa.



CURRENT TRANSFORMERS P337

Type MR through-type ct for low-voltage metering indoors. New transformers have good accuracy and continuous current rating of 200%, while not exceeding temperature rise of 55 C. Accuracy is maintained over this entire current span so only two current transformers—200- and 400-amp ratings—are required to meter in the complete range from 10 to 800 amp.

These ct's are for operation up to 600 v with primary current ratings of 200 or 400 amp, to 5-amp secondary. Three-wire transformer is also available with a ratio of 200-200 to 5 amp.

Westinghouse Electric Corp, PO Box 2099, Pittsburgh 30, Pa.

SOLENOID VALVE P352

Series No. 4000 solenoid valve, designed for normally closed operation, uses a special dashpot to eliminate water hammer from sudden valve closing. Dashpot slows closing action of the valve 1½ to 2 sec. Valve handles temperatures up to 400 F. Small sizes will operate under differential pressures up to 150 psi.

Standard construction has cast-iron body with bronze piston. All bronze can be furnished. Valve and seat are stainless steel. Units are available in ¾, 1, 1¼, 1½, and 2 in. sizes. Dashpot piston, set in the top housing of the valve, is pinned to the valve disk. An upward-seating ball check controls the flow through a port in this piston. When valve opens, piston moves up and liquid above piston flows through the port so there is no resistance to the instant opening of valve orifice.

Johnson Corp, Three Rivers, Mich.

SILVER-ZINC BATTERY P334

Silvercel is 1/3 to 1/5 weight of common batteries now in use and volume is ½ to 1/3. Energy efficiency is about 85% Normal cell voltage is 1.5.

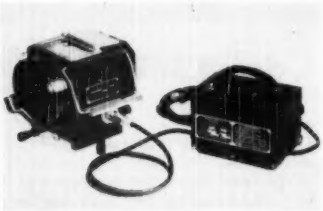
Unique construction eliminates hazards of leakage and spilling. Cell can withstand heavy discharge without damage. Five types of *Silvercel* batteries are now available ranging from 0.5 to 40 amp-hr capacity.

Yardney Electric Corp, 105-107 Chambers St, New York 7, N. Y.

CENTRIFUGAL PUMPS P320

Primarily intended to operate with flooded suctions they are built in long-coupled constructions in 1- to 4-in. sizes and 10- to 1000-gpm capacities. Unit may be installed to operate in either vertical or horizontal position. Impeller shaft is supported in oversized ball bearings. Shaft is sealed into pump by packing, but mechanical self-lubricated seals are available. Casing, regularly made of cast iron, can also be had in nickel, bronze, stainless steel, or other special alloys. Motors are ½ to 30 hp, splashproof protected. Explosionproof and fully-enclosed motors are also available.

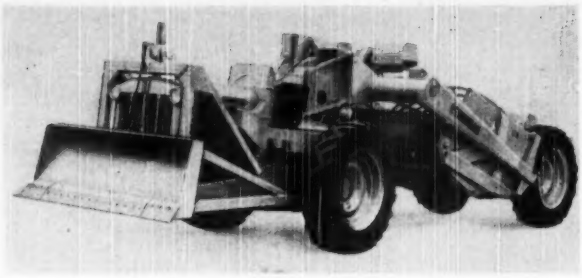
Marlow Pumps, Ridgewood, N. J.



INSULATION TESTER P325

Combination hand crank and rectifier-operated megohmmeter. Separate rectifier supplies 500-v dc from any 115-v ac 60-cycle outlet. Most important application is in communications, cable wiring and control installations where a great many tests are to be made and an ac outlet is available. Well suited where continuous operation of the instrument is desired, as in observing dielectric absorption effects.

Availability of the hand-cranked instrument, without the rectifier, makes it par-



DOZER SCRAPER P340

With new bulldozer blade attached, Model D *Roadster Tournapull* can be used either as a dozer or scraper in coal stockpiling and other applications. All tools are on one rig so no time is lost in changeover. Unit can also push-load other D's in fleet operation and can be loaded under its own power over the highway.

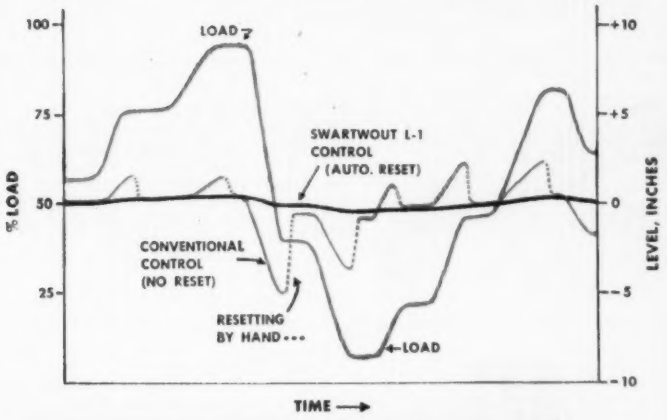
The dozer blade is suspended in front of the *Tournapull*, cable-activated, and controlled electrically by a switch on the dash. Blade has a bowl length of 6 ft, 8¾ in., height of blade and bowl is 32½ in. Cutting edge, which is reversible with hard-surfaced replaceable tips, can be raised 3 ft above ground.

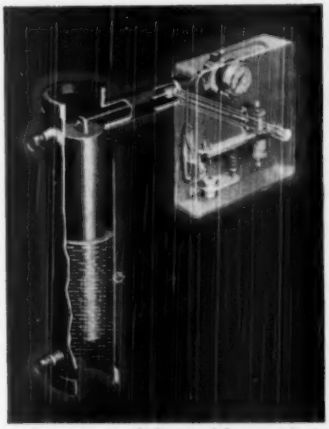
Maker also announced customers may have their choice of engine when ordering the Model C *Roadster Tournapull*: a General Motors 6-71, a Cummins HBI-600 or a Buda 6-DC-844. Now built for higher speed operation, the C roadster has a heavy-duty 5-speed transmission with a top road speed of over 30 mph in fifth gear. This high return speed is in addition to the four working speeds previously available, ranging from 3.0 to 19.8 mph. High return speed cuts cycle time on many jobs.

R G LeTourneau Inc, Peoria, Ill.

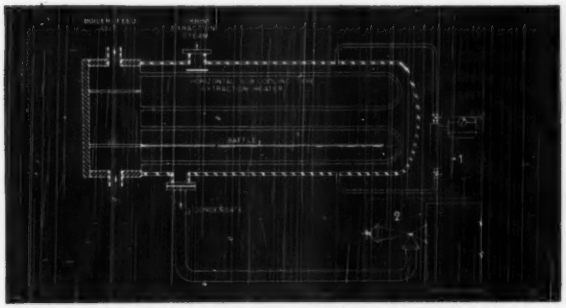
For further data on above items use reply cards on page 190a, identifying your request with letter P and number

Swartwout L-1 Control maintains condensate level within ±½ inch in horizontal subcooled heaters without manual readjustment!





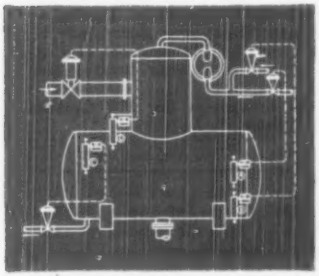
1 Operating on balance of forces principle, Swartwout L-1 Liquid Level Control has little actual movement of parts. Changes in liquid level vary effective weight of buoyant float . . . permit *complete control or throttling over full float length* of from 15 to 120 inches. Reset and setback features automatically compensate for any load condition.



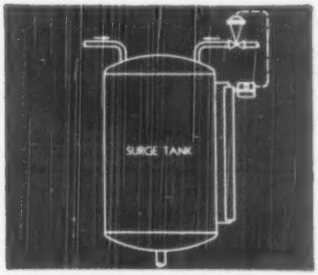
2 Horizontal subcooled heat exchanger *(above)* reduces degradation of heat in extraction steam by cooling condensate below saturation temperature. L-1 Control (1) holds level to ±½ inch for maximum heat extraction at any load. Swartwout V-10 regulating valve (2), with exclusive scroll inlet, withstands punishment of high-velocity flashing condensate.

Swartwout

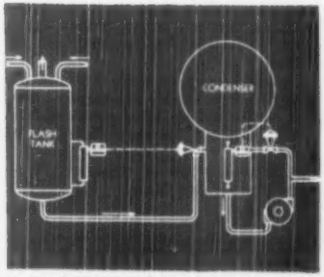
POWER PLANT EQUIPMENT



3 Deaerating Heaters.– Swartwout L-1 Controls are used for normal (A), emergency (B & D), and overflow (C) control. Also used in stage heaters for normal, emergency and by-pass control.



4 Surge Tanks.–Swartwout L-1 Control gives extended range over virtually entire height of tank for maximum "flywheel effect." L-1 Controls are also ideal for storage tanks.



5 Flash Tanks and Condenser Hot Wells. –Flash tank drains to hot well where Swartwout L-1 Control precisely maintains required level by controlling condensate recirculating pump discharge.

A-2764

SEND FOR BULLETINS S-15-A, S-208A • THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

ticularly attractive to those who would use it in the field.
James G Biddle Co, 1316 Arch St, Philadelphia 7, Pa.

FLEXIBLE TUBING P345

Abrasion-resistant flexible tubing is designed specifically for conveying abrasive material. Fabricated from galvanized-steel strip, tubing is fully interlocked, and incorporates a galvanized-steel strip inner liner as an integral part of the tube.

Liner laps over spaces between the tube convolutions, giving a smooth inner surface to reduce friction and allow free flow of material being conveyed.
Chicago Metal Hose Corp, 1302 S. Third Ave, Maywood, Ill.

FLAME DETECTOR P342

Protectoglo eliminates previous limitations in electronic safeguards for many processes. Used on oil- or gas-fired burners, the instrument operates on flame-rectification principles.

The device applies alternating current to either a flame electrode immersed in the flame or to its photocell sighted at the flame. Meets the latest requirements of Associated Factory and Underwriters Laboratories.

Protectoglo provides instant response to flame conditions. It can be interlocked with any combination of control devices and accessory equipment.
Minneapolis-Honeywell Regulator Co, Belfield Valve Div, Philadelphia 44, Pa.

PROTECTIVE COATING P357

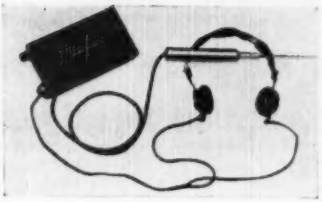
Dampney silicone coating aluminum, a semiorganic material, combines high inertness and heat stability with unusually high water repellency and low moisture absorption to provide heat- and weather-resistant surface protection.

Withstands either continuous exposure to heat or intermittent heating and chilling, and all conditions of weather exposure as well as chemical-fume attack. Manufacturer recommends it for such equipment as stacks, furnaces, boilers, heaters, ovens, steam lines, gas burners and exhaust mufflers.

Coating is easy to apply by brush or spray to any reasonably well-prepared iron, steel, galvanized or other metal surface. Either new or old coverage is about 1000 sq ft per gal.
The Dampney Co of America, Hyde Park, Boston 36, Mass.

OINTMENT FOR BURNS P309

First-aid jelly ointment for burns, *Americaine*, comes in a 2-tube unit carton. Product is designed to overcome the problem of a painlessly-removable water-soluble jelly ointment.
Davis Emergency Equipment Co, Inc, 43 Halleck St, Newark, N. J.



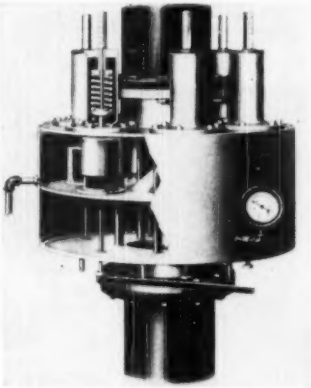
SOUND PROBE P363

Electronic sound probe brings sound source to a focal point by amplifying without distortion. It is designed to replace all makeshift sound probes such as welding rods, steel pieces, etc.

New device both localizes and amplifies sound so it may be accurately traced.
Como-Tex Co, 128 W Lake St, Chicago 1, Ill.

TEMPERATURE INDICATORS P361

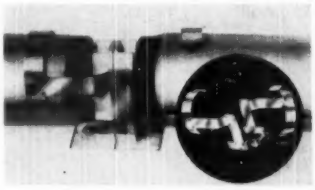
These pellets placed on heated surface begin to melt when surface reaches the temperature for which the pellet is rated. In five ratings—2100, 2200, 2300, 2400 and 2500 F—they complete the line of pellets formerly available in 12½-deg steps to 400 F, in 50-deg steps from 400 to 2000 F.
Tempil Corp, 132 W 22nd St, New York 11, N. Y.



AUTOMATIC VALVES P344

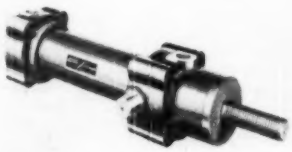
Type 135 VW maintains steam pressure at any desired point between 0 and 20 psi; type 136 VW is an automatic relief valve for vacuum service. Valves are multiport design, suitable for heating systems, power plants and process application.

Regulation of inlet pressure from closed to open valve position is accomplished because: (1) spring is unusually long, and its several inches of initial compression minimize increases in spring tension from valve lift (2) effective area of the cup-type inner valve is constant at all positions of valve opening; (3) velocity head of steam flowing through valve is used to increase static pressure in the cup, overcoming the small change in spring tension as the valve approaches full-open.
Klipfel Valves, Inc, Div of Hamilton-Thomas Corp, Hamilton, Ohio.



FLUORESCENT LAMP GUARD P330

Safety device for positive, permanent protection against falling fluorescent lamps in continuous run, end-to-end lighting installations. These lamp guards may be sprung aside for relamping and cleaning. Quickly and permanently installed with screwdriver.
Den-El Equipment Co, 271 Conklin Ave, Hillside, N. J.



HYDRAULIC CYLINDERS P347

Series LA hydraulic cylinders are available in 12 standard bores from 1 to 8 in., and 12 standard mounting arrangements.

Device follows practice recommended by JIC Hydraulic Standards for Industrial Equipment.
Vickers, Inc, 1596 Oakman Blvd, Detroit, Mich.

(*Continued on page 174*)

For further data on above items use reply cards on page 190a, identifying your request with letter P and number

It was 1912—and the Irving Berlin song, "When the Midnight Choo-Choo Leaves for Alabam" was the hit of the music halls—when we introduced "Flexitallic", the *original* Spiral-Wound Gasket, and opened to Industry new fields of opportunity in the confining of fluids at high pressures and high temperatures.

WHAT DO YOUR GASKETS COST . . . in place on the job?

Practically speaking, a gasket is a gasket only when it is working as a gasket—*in place on the job*—and its value is determined by how long it continues to maintain a safe seal.

It costs a lot of money when a gasket fails. The cost of the gasket is generally of minor importance. The real cost is measured in terms of operating loss, danger to personnel and labor costs for replacement.

That is why the great oil refineries, chemical industries, power plants, shipyards, ship operating companies and others, seriously concerned with high pressures and high temperatures, specify Flexitallic Gaskets . . . They know *from experience* that, in-place-on-the-job, Flexitallic is the most economical buy.

Flexitallic Gaskets are Spiral-Wound of preformed, spring-like metal, alternating, ply for ply with either metallic, or non-metallic filler. The V-shaped, interlocking crimp, imparted during the preforming process, gives Flexitallic Gaskets a flexibility which provides the necessary high resiliency for self adjustment to changes in operating conditions and bonding pressures.

If safe sealing is of serious concern to you, and you would like additional proof of the superior performance of Flexitallic Gaskets, write us today. Give us these facts on your sealing requirements: (1) Fluid to be confined; (2) Type of flange and dimensions; (3) Operating pressures and temperatures; (4) Bolting data.

In return, we will send you a genuine Flexitallic Spiral-Wound Gasket with our compliments. Examine it—test it severely—in your laboratory or on a job. The results will demonstrate to you why most industries vitally concerned with safe seals of high pressures and temperatures are standardized on Flexitallic Gaskets.

FLEXITALLIC GASKET COMPANY
Eighth and Bailey Streets, Camden 2, N. J., U.S.A.

The name "Flexitallic" is the registered trade mark identifying the *original* (patented) Spiral-Wound Gasket. Now—for your protection and ours—this trade mark FLEXITALLIC is stamped into the outer ply of every *genuine* Flexitallic Gasket. Your guarantee of quality.

Have You Paid For Your Education?

I've always liked to call myself a self-made man, having only a grade-school education. Somewhere I got the idea that my climb to chief engineer was accomplished almost singlehandedly.

But on my last birthday I did a little reflecting about the past. I now realize that I just played a small part in getting where I am today. Any credit for my success must go above all else to what I learned from others.

Not just my parents and teachers did the teaching, but my brothers and sisters, fellow classmates, friends, Olaf, the big-hearted Swedish fireman who took me under his wing on my first job, my first boss and every boss since, my wife, even my kids. In short, every person I've met has taught me something . . . added to my education.

And why? Because they wanted me to do something in return? I don't think they were that selfish.

Because they wanted me to revel someday in luxury? I don't think they were that generous either.

I rather think my "teachers" wanted me to put my education to work, not just to earn a weekly pay check, but to help others live well and live happily . . . to do what I can to make the world a better place.

But what can a mere power engineer do? Well, take Bob Jennings, chief engineer in a large office building.

His kids were always catching colds. So one day he took a look at the heating plant in the grade school of his suburban town. It was in sad shape. And with firing done merely at the janitor's whim, the building was usually too hot or too cold. No wonder the kids caught cold so easily.

Bob put his engineering to work and designed a set of heating controls. After a little persuasion, the school board bought the idea and all the kids in the community benefited. Since then Bob's found so many other jobs that need doing around the school that the people have elected him president of the school board. He's going to tackle classroom lighting next.

Then there's Al Bronson. He's a plumbing contractor and trustee of our church. Our congregation is small and the church is old. It always needs repairs, but we don't have much money to spend on them. So when the plumbing or heating systems develop trouble, Al not only donates the replacement parts, but does the monkey-wrench work himself.

And what am I going to do? I just finished talking to Jim Daniels, the science teacher down at the high school. We've cooked up a scheme where the boys from his physics classes come down one Saturday a month to my plant and study physics in action. There's hardly a physics law in the book that can't be demonstrated in a power plant. And maybe the kids will study with more purpose once they know schoolbook formulas really work.

So I think each one of us—if we're at all honest with ourselves—will find he owes a tremendous debt to society for his education. And how best to pay back that debt? Just look around your own home town, and you'll find lots of places that need your knowledge badly.

George Edwards

Engineer

DOWELL

SPECIALISTS IN SCALE AND SLUDGE REMOVAL WITH CHEMICALS

Condenser efficiency restored-

by Dowell Service

The water sides of fifteen tube and shell condensers in a West Texas refinery were almost plugged by heavy scale deposits. Dowell was called in to clean them. After a six hour soaking with specially selected Dowell solvents, they were flushed out and returned to service. Following this chemical cleaning, gasoline left the condensers 20°F cooler than after a previous mechanical cleaning. *The improvement in operating economy paid for the job in 12½ days!*

When you specify Dowell Chemical Scale Removal Service for your cleaning job, you get fast, convenient service. No scaffolding or dismantling of the equipment is required. Special solvents designed to dissolve or disintegrate the insulating scale are pumped in and out through existing connections. Costly down time is minimized.

Experienced Dowell engineers do the job. They bring the essential equipment — truck-mounted tanks, pumps, heaters, and chemical proportioners — to make possible step by step control of the work. Call the nearest Dowell office for fast, practical and economical removal of scale and sludge from all types of heat exchange equipment, steam generators, water lines and water wells. Free cost estimates gladly given.

DOWELL INCORPORATED · TULSA 3, OKLAHOMA

SUBSIDIARY OF THE DOW CHEMICAL COMPANY

CALL

New York 20	Cleveland 13	Wichita 2	Hamilton, Ohio
Boston 16	Pittsburgh 19	Oklahoma City 2	Charleston 27, W. Va.
Philadelphia 2	Detroit 2	Houston 2	Salem, Illinois
Baltimore 18	Chicago 2	New Orleans 12	Borger, Texas
Wilmington 99	St. Louis 8	Ft. Worth 2	Midland, Texas
Richmond 19	Indianapolis	Shreveport 23	Wichita Falls, Texas
Atlanta	Louisville	Anniston, Alabama	Lafayette, La.
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Long Beach, Oakland, Casper: Dowell Associate—International Cementers, Inc.

DOWELL

A SERVICE ORGANIZATION

A QUICK ECONOMICAL way to clean small tubes

ROTOJET Junior Tube Cleaners offer advantages possessed by no other type. They are light in weight, fed easily with the hose, and shifted quickly from tube to tube.

The ROTOJET Motor is unusually powerful and efficient. It has only two moving parts, a shaft and a paddle. Positive contact, maintained between paddle and Rotocentric (egg-shape) bore cylinder, assures an undivided air stream and freedom from power loss. An air valve permits one-man operation. Models for straight and curved tubes .495" I.D. up. Water-driven models for tubes .953" I.D. up.

ROTOJET size, speed, and ease of operation offer a marked contrast with external cleaners costing many times as much. Send for new bulletin.

Roto Heads are economical

Roto Heads meet practically every cleaning need. Expanding brushes and scrapers have inexpensive replaceable elements for economical operation.

Expanding brush, ball joint, replaceable brush element.

Expanding scraper and replaceable element

Wire brush and adapter.

Sectional wire brush.

ROTOJET Junior TUBE CLEANERS

ELLIOTT COMPANY-ROTO DIVISION

153 Sussex Avenue Newark 1, N. J.

Niagara's Power

(*Continued from page* 117)

River to generate 120,000 kw in this plant, under a 100-ft head.

For a second plant, water is to be taken from above the Falls to generate 1,080,000 kw with twelve 90,000-kw units in a plant near Lewiston. This water is to be carried either in two 40-ft covered canals, each good for 24,000 cfs, or in three 40-ft pressure tunnels about 5 miles long.

A third important feature in the development is a 130,000-kw pumped-storage plant near Lewiston. During off-peak periods when there is an excess of water for power generation, this power will be used to pump water into a reservoir on top of Niagara Escarpment. The water will be used to generate peak-load power.

The pumped-storage plant will use 32,000 cfs from a reservoir of 22,000-acre-ft capacity. Pumping and generating plant would contain 10 units of 375,000-hp total capacity.

Storage in Lake Erie is also proposed by installing control work in Niagara River above the Peace Bridge at Buffalo, about 23 miles from Lewiston.

This program proposes a flow of not less than 100,000 cfs over the Falls and in the Rapids for daylight scenic purposes during the tourist season. Flow in excess of 100,000 cfs and up to a maximum of 100,000 cfs will be available for power-generation diversion. At night in the tourist season, all flow in excess of 50,000 cfs can be diverted for power purposes. It is assumed that the diversion for power will be divided equally between the U.S. and Canada.

A development using the U.S. share of the water would provide a total installed capacity of 1,690,000 kw, including Schoellkopf plant but excluding Adams, which would be used for voltage regulation and for standby service. Assuming a comparable use of water in Canada, a total installed capacity of nearly 5,000,000 hp would be justified on the two sides of the Falls.

Total dependable capacity in the U.S. would be increased from the present 440,000 kw to 1,572,000 kw, a gain of 1,132,000 kw. Average annual power generation would be increased from 3.7-billion kwhr to 11.6-billion. This is over three times the present generation.

Estimated Cost. Complete development would cost $308,700,000 using covered canals from near Connors Island to Lewiston, and $350,000,000 if tunnels are used in place of canals.

The proposed project should not be considered as new, because the general engineering for such an undertaking was done by the Niagara Falls Power Co nearly 30 years ago. This is, however, the first time such a comprehensive report has been made public.

WITH Chapman STEEL VALVES

you get <u>both</u> production-line economy <u>and</u> the precision rating of custom-made valves

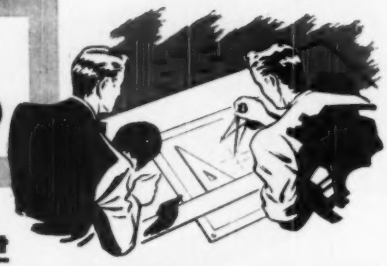
Because they're made with production line speed and economy, Chapman Steel Valves offer you important dollar savings. But you get more than just that — you get all the advantages of close quality-control from raw metal to final shipment to you.

Take the metals these valves are made from, for instance. Chapman's own metallurgists developed the alloys best suited to each application. And they supervise the production of every operation each time these metals are produced in our own foundries. Just one of the many reasons why Chapman Steel Valves give you better service.

Why not write today for more information on these valves that offer you *both top quality and economy?*

The Chapman Valve Mfg. Co.
INDIAN ORCHARD, MASSACHUSETTS

ASK ADSCO



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Few heating or cooling problems are exactly alike. In some cases, standardized equipment can be adapted for installation, with substantial savings in cost and delivery time. On the other hand, many problems require specially designed units to meet specific operating needs.

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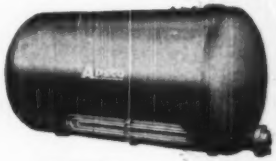
ADSCO instantaneous heaters include: convertors, water heaters, condensate coolers, booster heaters, oil heaters, economizers, etc. . . . gravity or forced circulation . . . vertical or horizontal . . . steam or water tube type. Usual construction is steel shell with removable copper U-tubes. Thousands of these ADSCO heaters are in use today.



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TECHNICAL BRIEFS

(*Continued from page* 134)

Steam

THE EVALUATION OF STEAM-POWER-PLANT LOSSES BY MEANS OF THE ENTROPY-BALANCE DIAGRAM, *by Allen Keller, assistant division engineer, General Electric Co.* The conception of a flow of entropy can, at times, be used advantageously to (1) evaluate different losses in a condensing-steam power plant, (2) get quick answers to the over-all effect of design changes. An entropy-balance diagram can do the job. Entropy is a measure of the unavailability of energy from the standpoint of a complete power plant consisting of boiler, turbine, condenser, feedwater heaters, pumps, and so on.

If entropy per pound of fluid is multiplied by fluid-mass flow, in pounds per hr, the product is entropy flow per hr. An entropy-balance diagram then is a chart similar to a heat-balance diagram. On it is represented rate of flow of entropy throughout the entire steam cycle of a power plant. There is one important difference.

On the heat-balance diagram the boiler, turbine, feedwater pumps, and condenser are the only places where heat or enthalpy is added or subtracted from the thermodynamic medium. At all other points enthalpy is merely transferred, as from steam to water in a feedwater heater.

An entropy-balance diagram, on the other hand, has total entropy increase in the thermodynamic fluid whenever a cycle loss takes place. As an example the author considers an extraction-steam pipe from turbine to feedwater heater. Pressure drop in the pipe increases entropy of steam flowing in the pipe. The hourly entropy increase within the pipe is a direct measure of cycle-output loss caused by pipe fluid friction. *ASME paper No. 49-A-65.*

SELECTION OF STEAM CONDITIONS FOR NO. 4 UNIT, RIVERSIDE GENERATING STATION, *by R C Dannettel and G S Harris, Consolidated Gas Electric Light and Power Co of Baltimore.* Four units were studied before final installation: (1) 66,000-kw 850-psig 900-F (2) 75,000-kw 1250-psig 950-F, reheat to 950-F (3) 75,000-kw 1450-psig 1000-F, reheat to 1000-F (4) 75,000-kw 1450-psig 1050-F. Estimates of installed costs for the four varied by less than 2% on dollar per kw capability basis. Second unit showed lowest installed cost with the fourth a close second. Third unit showed the highest figure.

Since no additional operating labor was contemplated for the new unit, this cost did not enter the evaluation. Fuel cost was based on assuming each unit

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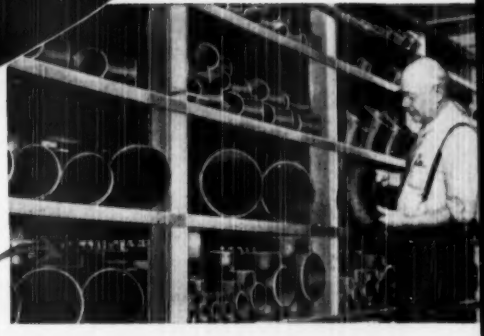

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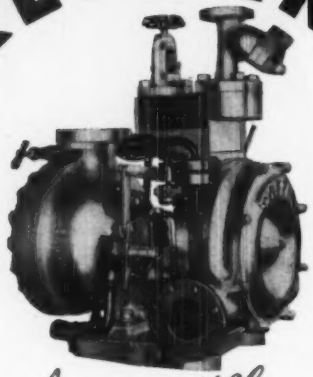

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would produce 66,000 kw for 6000 hr per year. Fixed charges on the 75,000-kw units were reduced proportionally to 66,000 kw for comparison purposes.

First unit had highest over-all annual operating cost, at $8.50 per ton fuel cost. This was $180,000 higher than the lowest cost, for the third unit, the 1000/1000-F reheat unit. The 1450-psig 1050-F unit was about $24,000 higher than the lowest-cost unit. This latter difference was considered within the limits of estimating accuracy. Hence, these two units were considered equal as far as fixed and operating charges were concerned. Final selection was made on the basis of estimated availability, reliability and maintenance.

Complicated reheat control gear lessens reliability somewhat. A reheat unit cannot easily adapt itself to sudden load changes from system disturbances and cannot be used for system-frequency regulation. Multiplicity of piping and controls might add to maintenance needs. Two superheaters and controls would be needed. Gains from reheat are doubtful during light-load operation, which would prevail when unit becomes older. Steam and fuel would be wasted at times to protect reheater from overheating.

Nonreheat unit has a single superheater and control with a minimum of high-temperature piping and valves. Using 1050-F steam presents no serious metallurgical problems. This plant should need less maintenance than a reheat unit. Considering maintenance and future light-load operation the nonreheat unit should be more economical overall during its life. *ASME paper No. 49-A-62.*

A Comparison of Costs of Reheat vs Nonreheat for 100-Mw Units, *by R P Moore, Buffalo Niagara Electric Corp.* This study divides a plant according to the way parts vary with reheat and nonreheat designs. Parts of the plant are grouped as follows:

I: *Size varying inversely with cycle efficiency:*
Coal storage — Dust collectors
Coal handling — Ash disposal
Fuel-burning equipment — Fans, ducts
Boiler-house structure
Auxiliary electrical equipment

II: *Size varying more than efficiency indicates:*
A. Direct with cycle fluid flow
High-pressure steam pipe
Condensate boiler feed pumps
Condensate and feedwater piping
Feedwater heaters and piping
B. Direct with heat rejection to condenser
Condenser surface
Circulating-water pumps
Intake and discharge flumes
Screening equipment

(*Continued on page* 160)

Oil in steam condensate reduced to less than .25 p.p.m. with the new . . .

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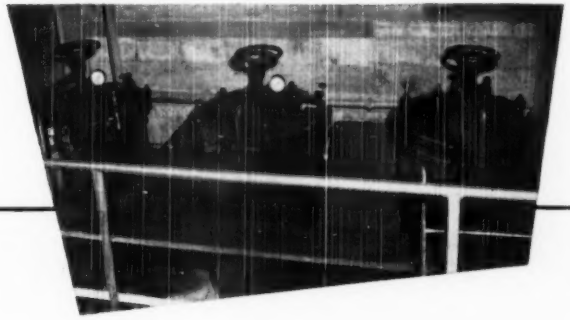

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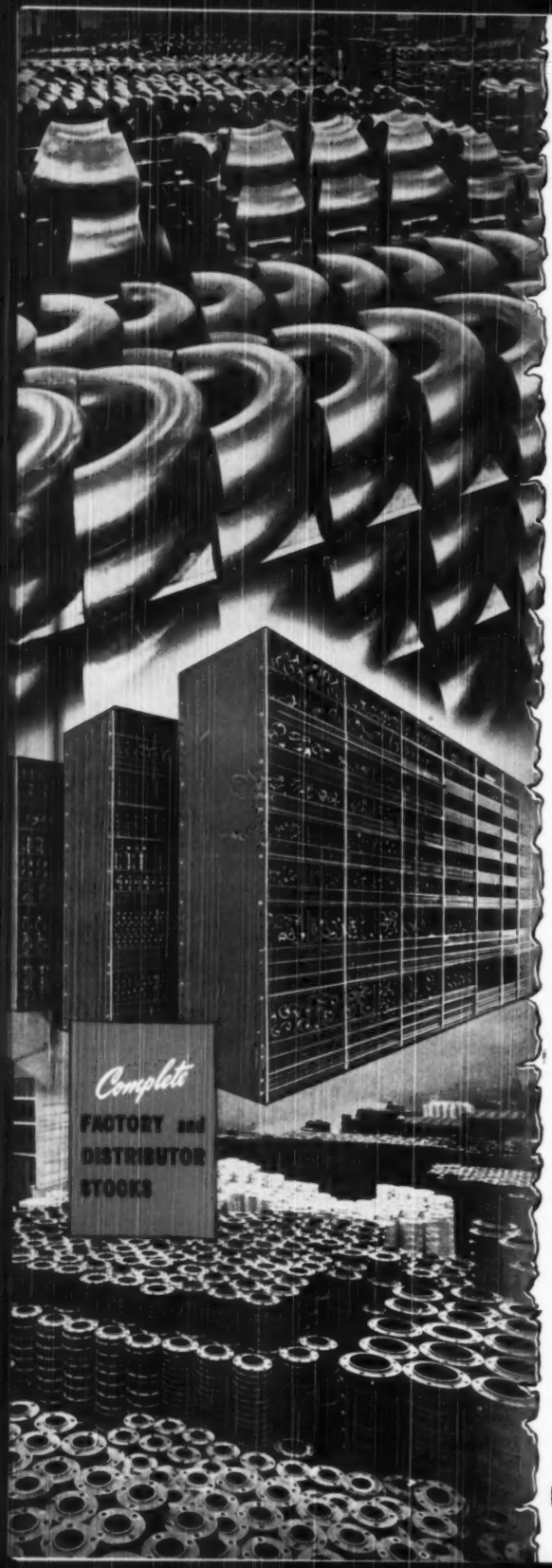

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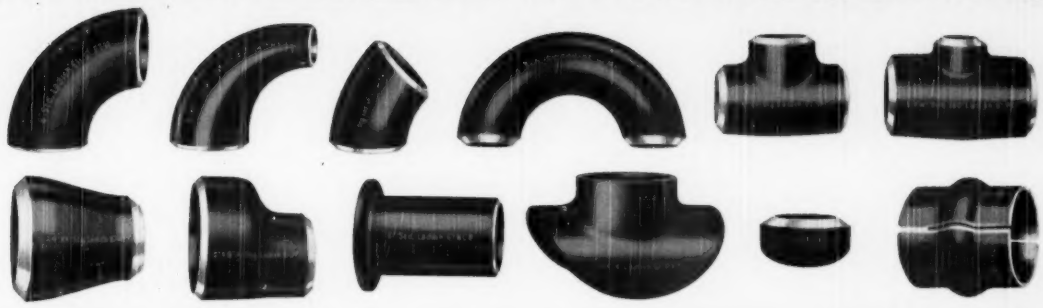

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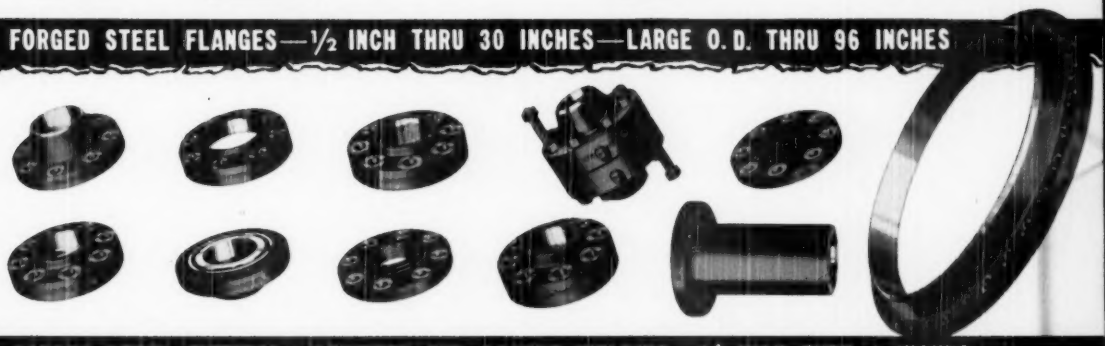

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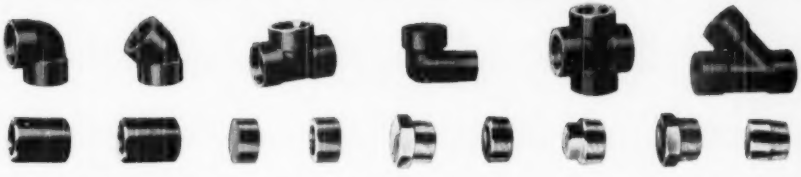

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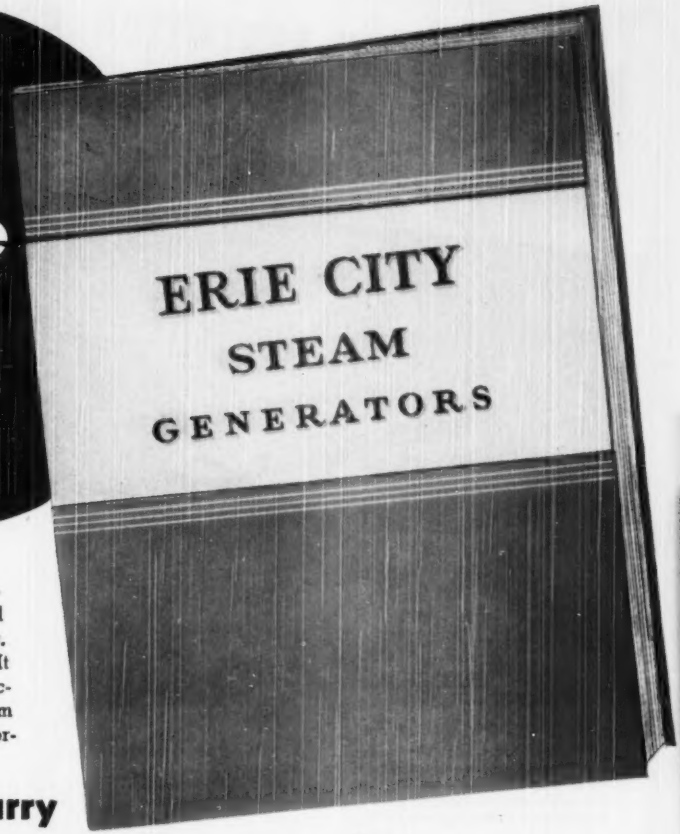

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IV: *Cost more for reheat, same capability:*
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Recent cost data show the items in category I total about $22.50 per kw capability. Category IIA totals about $8, and IIB about $7.50 per kw. Items in IV cost about $3.88 per kw more for reheat units. Other studies show, for 1450-psig 1000-F throttle conditions for both cycles and 1000-F reheat, the latter cycle gains 5% in economy over the nonreheat unit. In the reheat cycle, cycle-fluid flow is 16.4% less at full load, and heat rejection to condenser 8.7% less.

A machine, having 10% greater capacity, costs only about 7% more. This proportion varies somewhat, but is close to most price-book figures. The 7/10 factor is used in evaluation below.

Credits for the reheat-cycle items in the various categories are figured as follows:

(I) $22.50x0.05x0.7 = 79¢ per kw
(IIA) $8.00x0.164x0.7 = 92¢ per kw
(IIB) $7.40x0.087x0.7 = 45¢ per kw
Total credit for reheat = $2.16 per kw

Debits against reheat arise from higher cost of items in category IV; which total $3.88 per kw. Net cost for reheat = 3.88–2.16 = $1.72 per kw.

With coal costing $7.50 per ton, a coal rate of 0.8 lb per kwhr and 5000-hr-per-year operation saving by using reheat would be 75¢ per kwyr. Allowing 10% for interest, insurance and taxes leaves 58¢ per kwyr to write off the additional cost in 3 yr. If coal costs half as much, the writeoff can be completed in 8 yr. No allowance is made for additional operation or maintenance since the writer feels none is needed. *ASME paper No. 49-A-99.*

SOME FACTORS INFLUENCING THE ECONOMICS OF REHEAT INSTALLATIONS, *by R W Hartwell and H A Wagner, Detroit Edison Co.* Studies the effect on over-all cost of (1) capacity availability of different unit layouts (2) different maintenance schedules (3) assignment of capital charges as influenced by the average capacity available. Results of this study are intended as the starting point for investigating throttle conditions, different sizes, turbine types, station design, heat-cycle arrangement, etc.

Four arrangements are studied: (A) four 100-mw turbines supplied by battery of five 970,000-lb-per-hr boilers (B) four 100-mw turbines each supplied by one 970,000-lb-per-hr boiler

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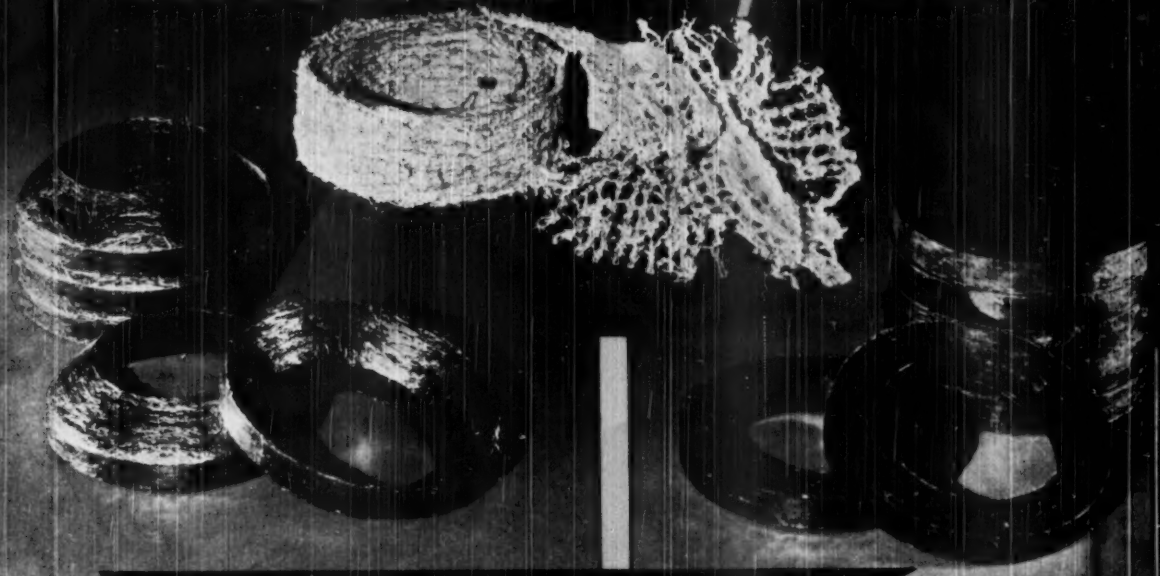

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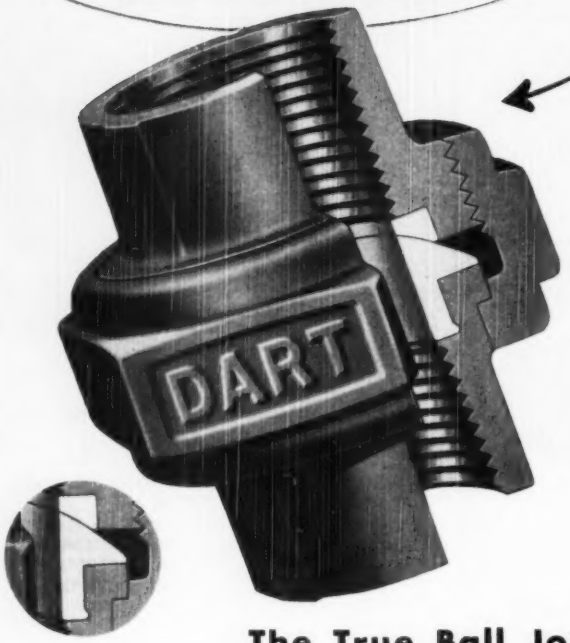

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with no steam tie (C) four 100-mw turbines supplied by battery of four 1,100,000-lb-per-hr boilers (D) four 100-mw reheat turbines each supplied by one 800,000 lb-per-hr boiler with no steam ties. First three plants use 1300-psig 950-F steam. Reheat plant uses 1450-psig 1000-F steam with 1000-F reheat.

In all schemes each turbine has two full-sized condenser pumps and three half-sized boiler feed pumps. Five feedwater heaters are used in *A*, *B* and *C* and six heaters in *D*.

On the Detroit Edison System summer peak loads are only 12% less than winter peaks. Since higher circulating-water temperature reduces station capacity about 4% in summer, only about 8% of winter peak capacity is available for summer maintenance. This equals about 120 mw. Overhaul scheduling for this system, which includes 28 units, many of 75- and 100-mw capacity, is seriously affected by machine availability.

To establish a new plant-maintenance schedule, average outage time for boilers and turbines is forecast for a minimum 35-yr period. Two schedules were assumed, one based on single-shift maintenance and one on double-shift. Each schedule uses approximately the same number of actual man-hours. These schedules together with average unscheduled outages of two weeks per year give these availabilities:

	SHIFT		OVERHAUL	
Plant	*A*	*B*	*C*	*D*
1	95.2%	90.4%	93.8%	90.4%
2	96.9	94.2	96.0	94.2

In making evaluations, capacity charges were applied as fixed charges on investment to provide the difference in average available capacity. To study its effect the capacity charge was applied at rates of 0, 50 and 100%. Many practical considerations make debatable the problem of how much of the charge should be applied in a given condition.

Original paper shows results for the partial study as a series of curves. These bring out the marked effects of plant factor, single- and double-shift maintenance and fuel cost. The reheat installation always appears favorable except when 100% capacity charges are assigned, or annual plant factors less than 60% occur. The higher throttle conditions and extra bleed point assumed for the reheat plant give it an advantage. *ASME paper No. 49-A-100.*

Southern California Edison Co contracted with Westinghouse Elec Corp for two 120-in. butterfly valves for the utility's No. 4 power house. These valves will regulate flow of water to hydroelectric generators at the power house on San Joaquin river, 53 miles northeast of Fresno.

Now—Gulf Turbine Flushing Oil has been further fortified to provide an even more effective rust preventive film! Now you can be sure that all oil bathed surfaces in your new turbine lubricating system are completely protected!

Gulf Turbine Flushing Oil has highly preferential wetting characteristics — displaces water quickly on the internal surfaces of the lubricating system. It should be used as soon as practical after installation of the system.

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An important advantage of Gulf Turbine Flushing Oil over other types (such as certain solvents) is that the undrained portion in the turbine system does not impair the lubricating value of the turbine oil. For Gulf Turbine Flushing Oil is itself a satisfactory lubricant.

Only one-third to one-half of a normal turbine oil fill is required for thorough flushing. Thus the expense of flushing your new turbine with low-cost Gulf Turbine Flushing Oil is nominal.

For complete information on this quality product and for recommended procedure for cleaning your turbine, call in a Gulf Lubrication Engineer. Write, wire, or phone today.

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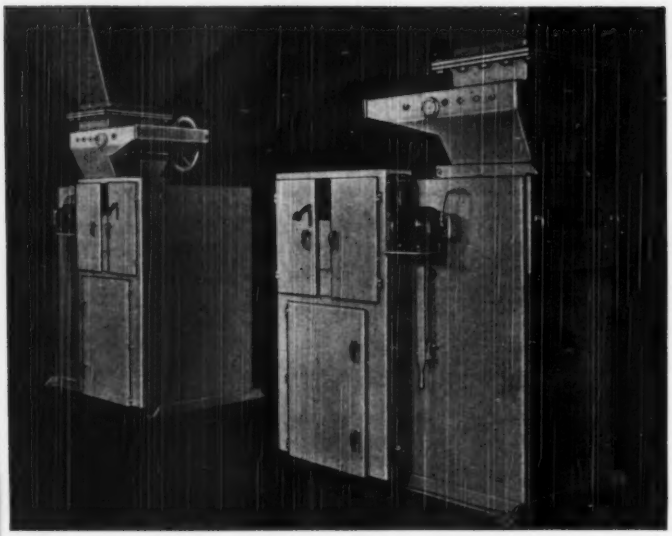

ENDLESS FEED BELT EASILY CHANGED

on S-E-CO. COAL SCALE

It is a simple procedure to replace an endless feed belt on a S-E-Co. Coal Scale. Remove two pins in the by-pass linkage, withdraw entire feeder through the feeder access door, set feeder on its side as shown in the photograph, loosen belt, remove—that's all—two man-hours are more than enough for complete belt replacement.

Easy replacement of the endless feed belt is but one of the many features that make the S-E-Co. Scale the one to use in your boiler plant.

For bulletin write

STOCK ENGINEERING COMPANY

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ELECTRONICS

(*Continued from page* 122)

relays used with them that they may be considered instantaneous for such purposes. Tests show that the cells' response is sufficient to record the passage of a rifle bullet through a light beam directed at a cell. But the cell's output decreases as the frequency of interrupted light increases. With suitable compensating arrangements it is possible to obtain acceptable frequency response for audio frequencies (20 to 20,000 cycles per second).

Even though photoelectric-cell connections are generally simple, due consideration must be given to their characteristics when a cell is to be included in a circuit. Internal resistance of the cell acts as a shunt across its terminals and, when connecting it to an instrument or relay, this must be kept in mind to obtain conditions satisfactory to the cell.

Meter Connections. Fig. 13 shows the simplest connection for a meter or relay. If the meter's resistance is high its indications will not be in proportion to to light-intensity change, as indicated by the curves, Fig. 10 and 11. Also, if the internal resistance of the cell under conditions of use falls below the critical damping resistance of the instrument, the latter may become sluggish when connected to the cell and shunted by its internal resistance. The circuit, Fig. 13, is limited in its use as the cell's response is not a straight line for circuits of high resistance.

Some of the objections of the circuit, Fig. 14, are eliminated by shunting a resistor across the meter, Fig. 13. This resistance lowers the effective external-cell resistance so response of the meter is proportional to light-intensity change.

This article gives a general picture of photovoltaic cells, how they work, their characteristics, and some of their circuits. In a later article we will consider their use in commercial smoke-recorder circuits.

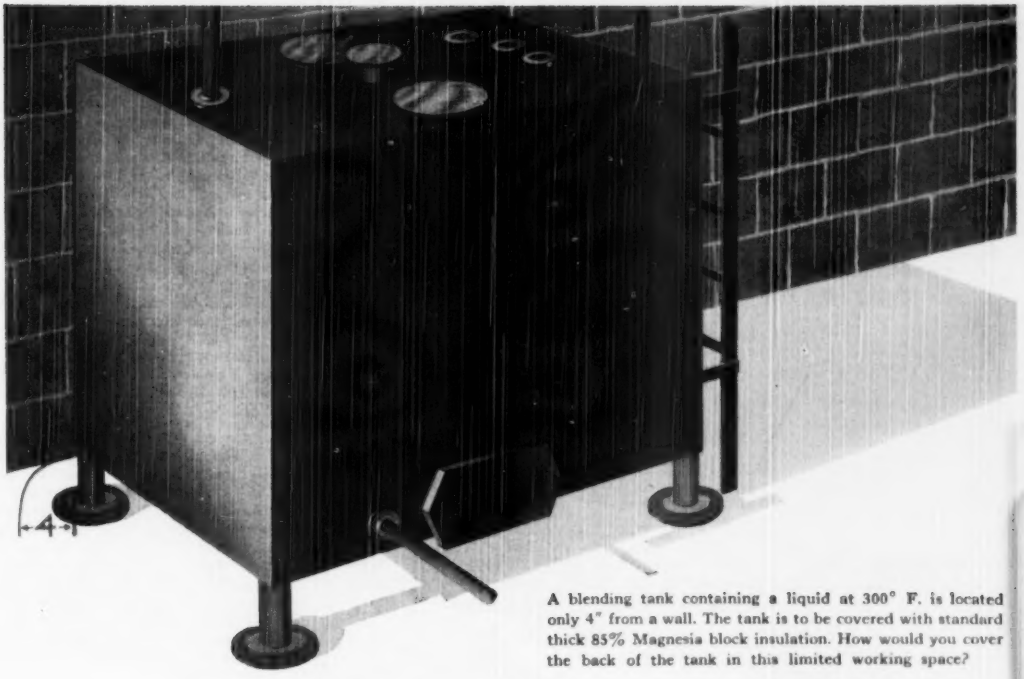
Literature of the Weston Electrical Instrument Corp, General Electric Co and Westinghouse Electric Corp was consulted freely for this article.

BOOKSHELF

(*Continued from page* 136)

for English engineering terms, and vice versa. The author has, quite wisely, included all terms technically accepted, whether or not the critic might call them "good" Spanish. Along the same line, Spanish equivalents for English trade names are given wherever such usages have found acceptance.

ANALYSIS AND LUBRICATION OF BEARINGS. *by M C Shaw, Dept of Mechanical Engineering, MIT, and E F Macks, Lewis Flight Propulsion Laboratory, National*



A blending tank containing a liquid at 300° F. is located only 4" from a wall. The tank is to be covered with standard thick 85% Magnesia block insulation. How would you cover the back of the tank in this limited working space?

HOW WOULD YOU INSULATE THE BACK OF THIS TANK?

HERE'S WHAT THE ARMSTRONG ENGINEER RECOMMENDED:

In this case, the tank was completely set up, with all pipe connections made, when the insulation men were called on the job. It was impractical to disconnect all pipes and move the heavy tank far enough from the wall to get behind it and apply the insulation. The 300° temperature held in the tank was critical, and omitting the insulation on the back would have made temperature control difficult.

To solve the problem of applying the insulation, the Armstrong engineer recommended that blocks of 85% Magnesia be wired to expanded metal lath, cut to the same size as the back of the tank. Then an angle was welded to the bottom of the tank back, and the insulation was slipped in place. The angle supported the weight, and wires were used to hold the insulation firmly in place.

This problem is typical of the many questions that arise on any heat insulation job. Armstrong engineers and installation mechanics experience them every day. That experience has taught them the answers to almost any insulation problem, large or small. When you have an insulation question you're in doubt about, consult an Armstrong engineer. The next time you need a heat insulation job done, try Armstrong's complete Contract Service, for dependable engineering advice, quality materials, and expert workmanship.

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MATERIALS (A) INSTALLATION

FOR ALL TEMPERATURES FROM 300° F. BELOW ZERO TO 2800° F.

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Type of Operation...

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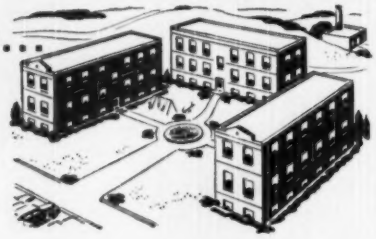

OPERATING CONDITIONS: Winter months—Average per month.

Evaporation — 8,098,000 lbs.

Make-up — 34,103 gal.

Degree days — 1,296

PROBLEM: Corrosion in steam and return lines. Pitting of receiving tanks. Rust deposits interfered with operation of traps and vacuum pumps.

CORAVOL STARTED: September 1939.

RESULTS: Corrosion stopped. No further deterioration of lines and receiving tank. Traps operate perfectly. All rust deposits removed.

USER COMMENTS: "Pipe pounding and heating complaints have been eliminated. The receiving tank has not been blown down for over a year and the water in it remains as clear as crystal."

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CORAVOL in your steam system (1) prevents corrosion in lines, (2) cleans out clogging rust deposits. Thus, CORAVOL *protects lines;* improves heat transfer; restores original capacity of lines and efficiency of valves and traps.

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*The use of CORAVOL in steam systems is covered by U. S. Patent No. 2053024. The Western Chemical Co., owner of this patent, grants licenses under which volatile AMINES purchased from other sources may be used in steam systems upon payment of royalty to Western Chemical Co.

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Advisory Committee for Aeronautics, 6½x9¼ in., 611 pp, $10, McGraw-Hill Book Co, 330 West 42nd St, New York 18, N.Y.

This advanced work provides material for a senior or graduate course in lubrication theory. Purpose is to present the fundamental concepts underlying design and performance of shaft bearings.

General principles of bearing load are first developed, and a number of representative examples discussed. Dimensional analysis is then introduced to generalize the results of bearing-load computations. A series of chapters is devoted to principles and practices of hydrodynamic lubrication, followed by a discussion of rolling contact bearings.

A MESSAGE FOR GREATNESS *(1949). By David O Woodbury, 230 pp, 6x9, illust. $4. McGraw-Hill Book Co, 330 W 42nd St, New York 18, N. Y.*

Here for the first time is the story of Edward Weston, famous scientist, engineer and electrical inventor. Because of the company that bears his name he is generally associated with electrical measuring instruments. But he was in this country 20 years before he turned his genius in that direction. In those years he developed electroplating from crude hit-and-miss methods into scientifically controlled processes. For this work he designed and built dynamos to replace the primary batteries previously used to supply the plating current.

This work led to invention of arc lamps and dynamos to light them. In fact, it was Weston's arc lamp and dynamos that first lighted the Brooklyn Bridge in 1873. After contributing substantially to development of the incandescent lamp he turned his attention in 1886 to the work for which his name became synonymous, highly accurate and reliable electrical instruments. When he retired he had taken out over 300 patents covering many phases of electrical equipment.

TRANSFORMER PRINCIPLES AND PRACTICE *(2nd edition). By J B Gibbs, design engineer, Westinghouse Electric Corp, 236 pp, 9¼x6¼ in., $3.50, McGraw-Hill Book Co, 330 W 42nd St, New York 18, N.Y.*

Construction and use of transformers, including underlying principles, applications, connections, testing, maintenance and economics. Mathematics is avoided in this basic treatment that concerns itself with both the why and the how.

From fundamentals of transformer performance and construction the book goes on to describe the many types of transformers, large and small, for various purposes. Special applications of standard transformers are covered, including phase transformation. This revised edition includes a new chapter on current-limiting reactors.

STANDARDS OF TUBULAR EXCHANGER MANUFACTURERS ASSOCIATION, *94 pp, wire bound; paper, $3; fabrikoid, $4. Tubular Exchanger Mfrs Assn, 53 Park Place, New York 7, N. Y.*

First publication since the original in 1941 is the work of eleven leading manu-

(Continued on page 168)

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a fine
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facturers of shell and tube heat exchangers. Their work is valuable to design, manufacture, specification, purchase, operation or maintenance of tubular exchangers.

This comprehensive, well-illustrated volume covers many subjects, such as fouling factors, temperature and temperature differences, heat transfer and pressure-drop data, thermal properties of fluids.

HANDBOOK OF MACHINE DESIGN AND CONSTRUCTION (*2 volumes, 10th edition, 1949*). *By Professor Heinrich Dubbel. 1500 pages, 2900 illust, 5x8, cloth. Price 28.50 D Marks. Published by Springer-Verlag, Berlin, Germany.*

A corrected reprint of the 9th edition. For engineers familiar with German, Volume 1 gives an extensive survey of the mechanical and mathematical fundamentals. Treatment is moderately technical.

Volume 2, dealing more with actual equipment, is of somewhat less interest to American engineers because designs pictured follow European practice.

SMOKE PREVENTION ASSOCIATION OF AMERICA, INC, *42nd annual meeting papers, 188 pp, 8½x11, paper, 23 articles, 22 illust, $2. John Paul Taylor, publisher, St. Joseph, Mich.*

All papers presented at the 1949 meeting of the Smoke Prevention Association, Inc in Birmingham, Ala. make up the book. They were presented by consulting engineers, smoke inspectors, railroad engineers, equipment manufacturers, industrial operators.

Included is a highly interesting one on the "Health Aspects of Air Pollution," by A J Lanza, MD. He answers many of the rather wild statements against smoke and atmospheric pollution.

THE V.I. STORY. *By David O Woodbury, 88 pp, 5½x7½ in., paper, $1. The Varnished Fabric and Paper Section, National Electrical Manufacturers Assn, 155 East 44th St, New York 17, N.Y.*

Designed to serve the electrical industry, at all levels, as an authoritative reference book on varnished insulation. Book covers nature and purpose of varnished insulations, origin, development, and use in rotating equipment, transformers, cables and motor controllers. Technical details of manufacture and application are omitted.

INDUSTRIAL ELECTRONICS CONTROL *(2nd edition, 1950). By W D Cockrell, Industrial Engineering Division, General Electric Co, 385 pp, 5½x8 in., illust, cloth. $4. McGraw-Hill Book Co, 330 W 42nd St, New York 18, N. Y.*

Industrial electronics are expanding at an ever-increasing rate, so this practical book has been revised and enlarged by 111 pages of new material. Its 22 chapters are grouped in five sections: electron tubes, circuit components, basic electronic circuits, closed-cycle control systems, and industrial-control circuit.

Functions of various tubes as parts of circuits are stressed rather than what goes on in the tube. Industrial symbols for electronic and electrical devices are used so the reader will be familiar with

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FLOATING SHAFT?
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HEAVY DUTY?
REVERSING?
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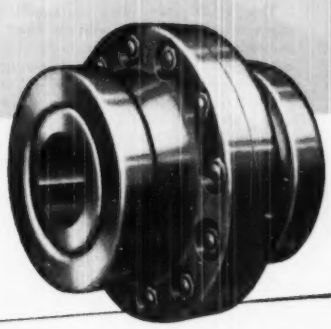

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Much attention is given to industrial electronics circuits and how to analyze them. Included are shop wiring diagrams and redrawing them in simplified form. Operation of many devices is worked out in detail. Of great value to the electronic industrial worker are the simple explanations of electronics in closed-cycle controllers, sometimes called feedback amplifiers or servo-mechanisms.

REWINDING SMALL MOTORS. *By Daniel H Braymer and A C Roe (3rd edition)* 422 *pp*, 6½x9¼-in., $4.50, *McGraw-Hill Book Co*, 330 *W 42nd St, New York* 18, *N.Y.*

This guide shows how to handle all types of winding jobs—whether hand or machine wound—from start to finish. It tells when and how motors can be changed, and gives fundamentals, methods and data required to do the work efficiently. Information on new materials, factory methods and processes.

Among the new-type windings is a bottom-to-top lathe or hand winding for dc armatures and the new single-loop high-speed lathe winding. Information is included on *Formex* and glass-insulated wire, silicone materials and windings.

LATHE OPERATOR'S HANDBOOK (*revised edition* 1949) 128 *pp, more than* 350 *illust: paper* 25¢; *imitation-leather fabrikoid* $1. *South Bend Lathe Works, South Bend* 22. *Ind.*

Reference book for experienced machinists or a textbook for apprentice or shop student. Eleven chapters include correct installation and leveling of lathe, grinding cutter bits, turning, boring, thread cutting, taper turning, drilling, reaming and tapping. Clearly written in simple, non-technical language, instruction material is easy for the beginner to understand.

Included is this new material: (1) New international screw-thread form. (2) Engaging apron half-nuts for cutting screw threads. (3) More complete description of thread dial indicator and its use. (4) Metric thread-dial indicator. (5) Universal tool block, machinability ratings and cutting speeds for steel. (6) Four-position carriage stop. (7) How to make lathe mandrels. (8) Use of coolant equipment, types of coolants. (9) Decimal equivalents of number drills and letter drills.

FREIGHT ELEVATORS (1949). 44 *pp*, 8½x11, 45 *illust, charts and tables, stiff paper; available when requested on company letterhead. Westinghouse Electric Corp, Jersey City, N. J.*

How to integrate selection of freight elevators with materials-handling problems is only one of many questions answered. Explained are the basic considerations when selecting freight elevators and their parts. Also told are how to determine lift capacity and size, type of elevator-control system, how to determine type of elevator-door operation, layouts for standard freight elevators, budget price information and special installations. The freight-elevator application curves are a timesaver.

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FACTORIES: Berkeley, Calif. and Teterboro, N. J.

Offices in All Principal Cities

Plant Problems

(*Continued from page* 130)

lubricant might make condenser tubes greasy, reducing heat transfer; large condenser is needed; vacuum will not be high.

Steam rate for a small noncondensing uniflow engine is somewhat higher than that of a small condensing turbine with its accompanying pumps. But its operation presents no problems. A diesel would run cheaper than either. And its jacket produces less heat per kwhr as the condensing turbine.

ARTHUR HOLT *Atlantic City, N.J.*

Provide Auxiliary Cooling

MA's PROBLEM IS somewhat similar to the diesel-cooling plan covered by Steve Elonka on p 30, Nov 1949, *Operating Engineer*. I suggest *MA* start by reading that article. Unfortunately, he neglected to supply sizes and quantities, so we can't do much computing.

I gather from the description that peak loads on proposed turbine and elevators coincide. But since turbine will operate intermittently there will be periods when heat previously absorbed by the elevator's hydraulic system can be dissipated either to the ground or the surrounding air. This is just a side-thought thrown in.

A good starting point is to get present water temperature to and from elevator cylinders. This will give him an idea on underground temperatures. Then determine total water and weight of metals in the system. Include metals in piping, pumps, cylinders and pistons. Knowing their specific heats, he can determine the number of Btu's per degree temperature rise the elevator system can absorb.

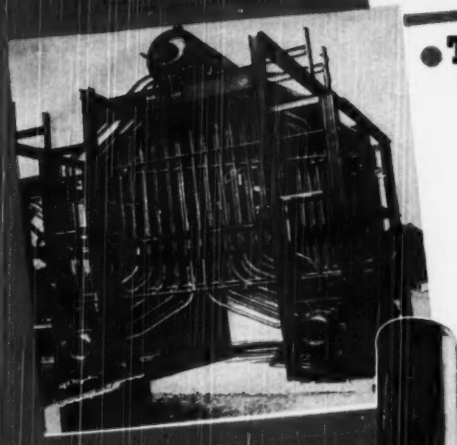
Next step is to find quantity of condenser cooling water required, considering maximum permissible discharge temperature. From there on, it's a matter of comparing requirements with the system's heat-dissipating abilities.

He should consider the high water pressure that will be impressed on condenser water boxes and tubes. An out on this score is to install condenser in the line between elevator cylinder and discharge tank. And don't forget a secondary condenser-cooling source, to assure water supply when elevators are not operating. This last angle would cover the case where the turbine-generator was needed on off-peak elevator periods.

Perhaps *MA* has overlooked the possibility of using a package-type diesel-generator. It may be the best solution, under the conditions.

H T LIVINGSTON
Los Angeles, Calif.

UNION
"H" TYPE
STEAM GENERATOR



•The Ideal Outdoor Unit . . .

THESE photos tell their own story of the adaptability of the Union "H" Type Steam Generator . . . the Ideal Outdoor Installation.

1. Compact, simplified design in a steel clad insulated setting with furnace inside the unit.
2. Drum and tube arrangement symmetrical . . . a tube bank on each side forming an integral water cooled furnace. No headers . . . No handhole plates required.
3. Superheater on one side only provides (patented) simplified superheat control over a wide load range for all fuels and varying excess air. Automatic adjustment of boiler outlet dampers controls gas flow across superheater.
4. Design accommodates any fuel or firing method for any desired capacity or pressure.

There are 13 basic Union boiler designs from which to specify *The One That Fits Your Job*—Write our engineers.

UNION IRON WORKS . . . *Since 1890*

301 CASCADE STREET • ERIE, PENNA.

BOILERS • PROCESS EQUIPMENT • FABRICATED STEEL

Clark presents DUO-STEP

A REVOLUTIONARY NEW IDEA IN STEAM TRAP CONSTRUCTION!

CLARK DUO-STEP "SHIFTS GEARS" TO DOUBLE DRAINAGE CAPACITY!

Double drainage capacity means double value for steam trap users! Because it increases drainage capacity over 100% Clark Duo-Step Leverage makes it possible to use *smaller, less expensive* steam traps for big volume drainage jobs.

This is accomplished by using TWO fulcrum points — one for power to "crack" the valve from the orifice and one to move the valve *away* from the orifice.

Send for the whole DUO-STEP story *today*, and start saving money on your steam trap requirements.

THE CLARK MANUFACTURING CO.
1831 East 38th St., Cleveland 14, Ohio

SEND FOR THE AMAZING DUO-STEP STORY TODAY!

Please send me the Duo-Step story:

NAME_____

COMPANY_____

STREET_____

CITY_____ STATE_____

NEW EQUIPMENT

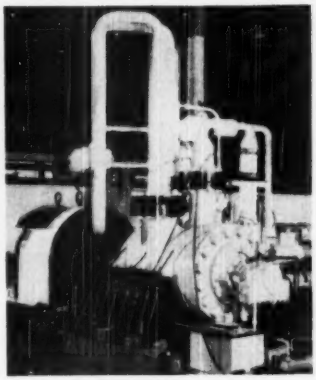
(*Continued from page* 150)

CHLORINE FEEDER **P349**

Chlorinizer meters chlorine gas to produce closely controlled concentrations of chlorine-water solution for process use, and slime and mussel control.

Feeder is readily adapted to semi-automatic, program or automatic proportional operation. Conversion from one method to any other may be made in the field. A positive chlorine rate indicator with direct-reading linear scale assures easy and accurate readings.

Builders-Providence, Inc, Div of Builders Iron Foundry, Providence 1, R. I.



BOILER FEED PUMPS **P318**

Combination of primary and secondary pump built into a single unit reduces installation space 30 to 50%, cuts first cost, eliminates one drive, one set of bearings and stuffing boxes. Part of feedwater heating occurs between the primary and secondary sections. This permits use of low-pressure heaters instead of high-pressure, commonly installed on conventional high-pressure pumps. Combination is for high-pressure boilers. One unit, driven by a 2025-hp 5000-rpm steam turbine, discharges 1980 gpm at 1570 psi. In the primary section, water is pumped at 255 F, and in the secondary section at 465 F.

Byron Jackson Co, PO Box 2017 Terminal Annex, Los Angeles 54, Calif.

CHAIN OILER **P332**

This solenoid-operated oiler lubricates conveyor chains automatically. Oiler feeds lubricant by gravity from a reservoir through a solenoid-operated valve and a sight-feed valve to a brush, which rides the chain. This brush spreads and wipes the desired amount of oil evenly on the chain.

Reservoirs are available in six sizes ranging from 9 oz to 1 gal in unbreakable Lucite or glass for temperatures above 160 F. Manually operated chain oilers can

Down time due to FOUL AIR adds more to your costs...

... than the blower that helps men do a fair day's work

Speed fresh, cool air into a furnace, manhole, tank or other confined area where men must work and you'll get faster, better work in return.

There's a portable, easily adaptable Coppus Blower or Exhauster for just about any problem caused by stagnant, hot or fume-filled air. The Blue Ribbon stands for precision engineering that assures peak performance at lowest cost. Check and mail the coupon today for the information that fits your particular problem. Sales offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG, BEST'S SAFETY DIRECTORY, MINING CATALOGS.

OTHER COPPUS "BLUE RIBBON" PRODUCTS

HORIZONTAL TURBINE
Six frame sizes —
1 to 150 horsepower

VERTICAL TURBINE
Six frame sizes —
1 to 150 horsepower

FANMIX GAS BURNER

FANMIX OIL BURNER

MAIL THIS COUPON To Coppus Engineering Corp., 163 Park Avenue, Worcester 2, Mass.

PLEASE SEND ME INFORMATION ON SUPPLYING FRESH AIR TO MEN WORKING:

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fusilages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausting welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.
- ☐ drying of walls, sheets; etc., after treated with coating material.

NAME .....

COMPANY .....

ADDRESS .....

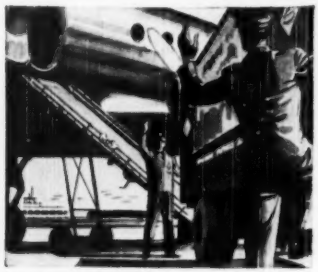
CITY .....

(Write here any special ventilating problem you may have.)

Press breaks down — but $2.88 keeps editions rolling

Press broke down at 5 P.M., at end of evening edition's run. But this publisher got replacement parts in a hurry the same way he gets electros, mats, news photos —by Air Express. An 18-lb. carton traveled 500 miles, was delivered by 11 P.M. Shipping charge $2.88. Morning edition published as usual.

Air Express is the best air shipping buy to keep any business rolling, since low rates include door-to-door service. Answers your problems because Air Express is *fastest* and *most convenient*.



All Scheduled Airline flights carry Air Express. So shipments *keep moving*. All business profits from its regular use. Improves customer service; manpower or equipment never stands idle.

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World's fastest shipping service.
Special door-to-door service at no extra cost.
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1150 cities served direct by air; air-rail to 22,000 off-airline offices.
Experienced Air Express has handled over 25 million shipments.

Because of these advantages, regular use of Air Express pays. It's your best air shipping buy. For fastest shipping action, phone Air Express Division, Railway Express Agency. (Many low commodity rates in effect. Investigate.)

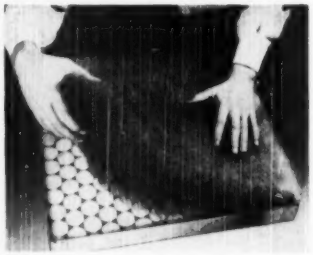
AIR EXPRESS
GETS THERE FIRST
Rates include pick-up and delivery door to door in all principal towns and cities
A service of
Railway Express Agency and the
SCHEDULED AIRLINES of the U.S.

also be furnished, having a needle valve instead of a solenoid valve.
Oil-Rite Corp, Milwaukee 15, Wis.

CONNECTOR TOOL **P331**

Hytool is designed for use with *Hydent* connectors over a large conductor range. This aluminum-alloy tool, Catalog No. MY4C, has spring-loaded jaws holding connector-and-cable assembly. It leaves both hands free to operate the tool.

Three grooves in the tool jaws accommodate connectors for No. 9, 8, 6 and 4 stranded commercial aircraft copper conductors. Die grooves handle entire range without any adjustments.
Burndy Co, 107 Bruckner Blvd, New York 54, N. Y.



AIR FILTER **P312**

Refill, glass-fiber air filter comes in reusable frame for all types of forced air-heating, ventilating and air-conditioning systems.

When the filter pack has accepted its capacity dust load, remove the light metal frame from the filter bank, unfasten, and discard the used pack. Put in a fresh pack, retape the frame, and return unit to filter bank.
Glassfloss Corp, Dept RF, Commerce Bldg, New York 17, N. Y.

TURBO-BLOWERS **P316**

Simple, reliable, efficient and economical turbo-blowers—single stage for low pressure, multistage for pressure above 24 oz.

All sizes operate at 3450 rpm. V-belt drives are available for larger units and units other than 60-cycle current. Standard, large-sized pillow blocks with double-row self-aligning ball bearings are used. Sparkproof corrosion-resistant aluminum impeller is furnished for all turbo-blowers.
U.S. Air Conditioning Corp, 3377 Como Ave, SE, Minneapolis 14, Minn.

AIR COMPRESSOR **P384**

Portable Mobile-Air *IKA-500* compressor has a capacity of 500 cfm and uses diesel-engine drive.

Heavy-duty *UD-24* engine starts as a low-compression gasoline engine and after warm-up is shifted to full diesel operation.

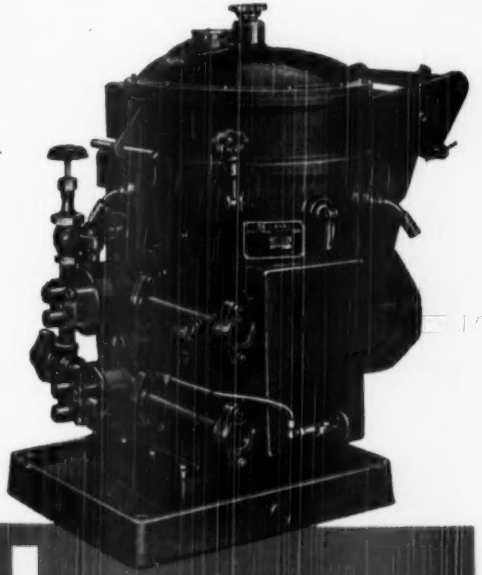
Full 500-cfm capacity is handled at rated 100 psi, and floating-speed regulator adjusts speed according to load. Compressor is a 2-stage air-cooled unit with *Hydro-Shift*

I STOP TROUBLE before it STARTS!

"I am De Laval Centrifugal Force. I am expert at removing dirt and water from lubricating oil — either turbine lube or Diesel lube. And because dirt and water are the chief causes of lubricating oil deterioration, I actually guard your power plant against trouble. I stop trouble where it counts — ***before*** it happens."

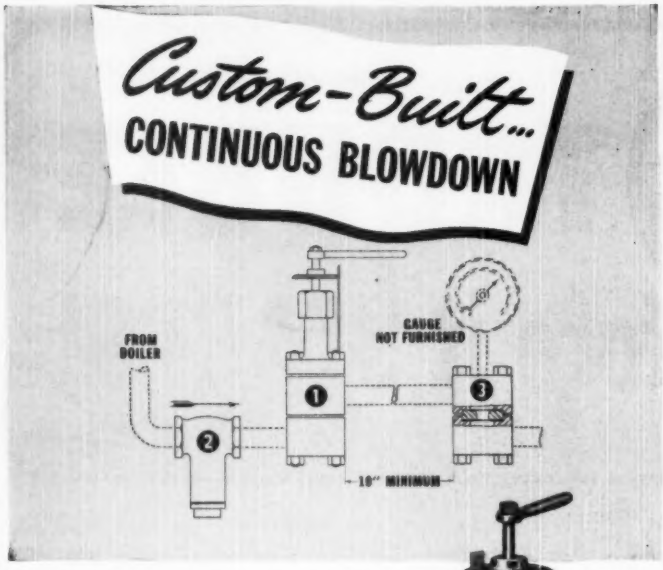
De Laval Centrifugal Force does its job thoroughly. The water is continuously discharged after being removed from the oil by centrifugal force, and the dirt is stored in the bowl, outside the zone where purification takes place.

De Laval Oil Purifiers offer still another advantage to plant operators — these machines have enough reserve capacity to take care of a sudden emergency, such as a surge of water due to a leak.



THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

De Laval OIL PURIFIERS



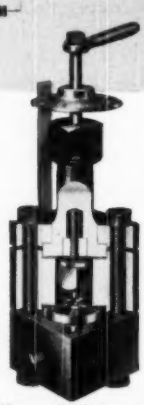
STRONG Dual-Orifice Assembly gives Greater Accuracy . . . Rugged Service!

Strong's Continuous Boiler Blowdown Assembly includes a Strong *block steel* Evrtyte* Valve (1), a strainer (2) and an orifice block (3), *custom-built* and accurately sized for *your own job conditions.*

The assembly is essentially two orifices arranged in series. The first orifice (valve) is variable . . . . the second is fixed. Correct proportioning of orifices provides extremely accurate control and reduces wire drawing.

Strong Evrtyte steel valves have special Anum-Metl X† seats and discs of 750 Brinell surface hardness for long life. Available for pressures to 1500 psi and temperatures to 800° F. or 6000 psi non-shock cold service.

Let us custom-size your continuous blowdown system. Send for Catalog No. 68 and our Continuous Blowdown Check-Chart today!



Also available in outside screw and yoke.

*Reg. Trade Mark

STRONG, CARLISLE & HAMMOND COMPANY
1392 West 3rd Street
Cleveland 13, Ohio

† Anum-Metl Reg. Trade Mark

Flex-Disc clutch and Channel valves.
Ingersoll-Rand Co, 11 Broadway, New York 4, N. Y.

PIPE THREADER **P310**

Portable, 160-lb, pipe-and-bolt threader, the *Chief*, for ½- to 2-in. pipe has four jaws, front, that automatically grip the pipe and four jaws, rear, that automatically center the pipe to eliminate whipping.

Chucks operate automatically when the push-pull switch is actuated. Simply pull to chuck, push to release. Cutting oil is pumped through telescoping oil lines onto cutting surfaces. A die head is used for each pipe size. A reamer attaches to each head and reams while threading. When the proper thread length is cut a bell rings to notify operator to open die head.

Quijada Tool Co, Inc, Los Angeles, Calif.

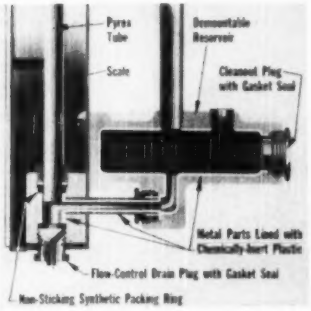
FITTING CAPS **P387**

Chemical, foundry, power-plant users of alemite dot fittings for lubrication of equipment in dirty, dusty places can keep fittings clean with plastic caps.

Elastoplastic caps fit over ⅜-in. dot fittings. They are made of black, flexible vinylite, easily applied and removed.
S S White Dental Mfg Co, Plastics Div, 10 E 40th St, New York 16, N. Y.

HIGH-PRESSURE SEAL **P355**

Fel-Pro, type H-P, seals are designed to handle a variety of liquids at pressures up to 600 psi and temperatures up to 250 F, in centrifugal pumps and other equipment handling crude oil, gasoline, propanes, etc.
Felt Products Mfg Co, Packing Div, 1508 Carroll Ave, Chicago 7, Ill.

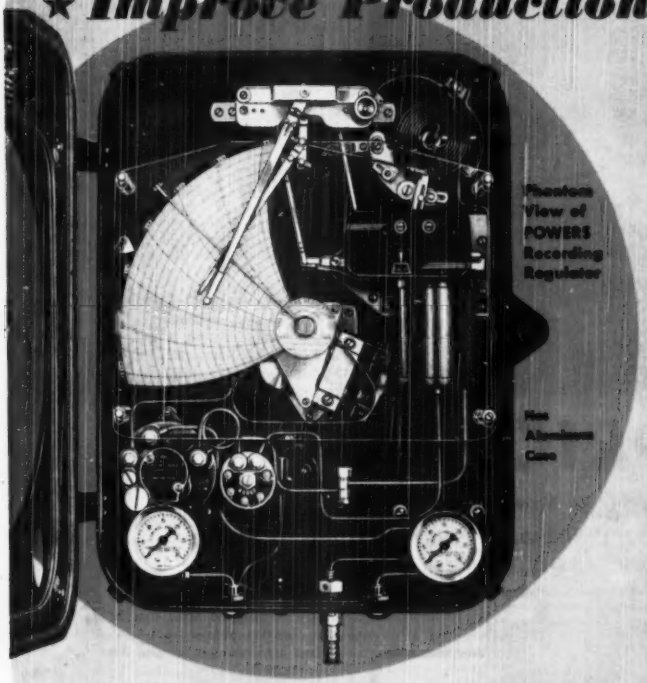


MANOMETER **P354**

Regularly available in 14 lengths with scales from 12 to 1.6 in., these manometers are good for line pressures up to 200 psi. They can be mounted flush, flat on a panel or wall, or on a table tripod.

Reservoir and connecting parts are steel or brass, or stainless steel on request and can be lined with a thermosetting plastic highly resistant to acids, and alkalis. Cleanout and drain plugs are straight-threaded and gasket-sealed to eliminate the use of sealing compound below the liquid surface.

★ REDUCE COSTS
★ Improve Production



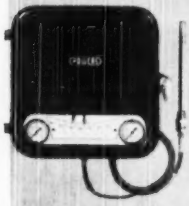
with precision control by—

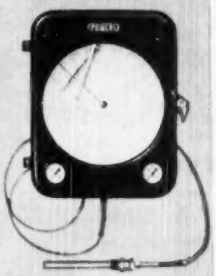
POWERS

Air-Operated
INDICATING AND RECORDING REGULATORS

For TEMPERATURE • HUMIDITY • PRESSURE

End losses caused by OVER-heating of processes or operations requiring precise control. Install POWERS pneumatic regulators. Their accurate control helps to improve quality of products—speed up production and save steam wasted by overheating.



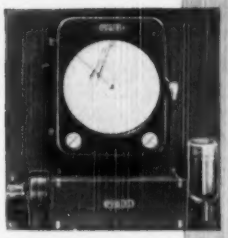


Variety of Models: Recording Thermometers; Recording Regulators; Indicating Regulators; Wet and Dry Bulb Recording Regulators; Time Cycle Recording Regulators; Master and Sub-Master Indicating and Recording Regulators, etc.

Write for Bulletin 370.

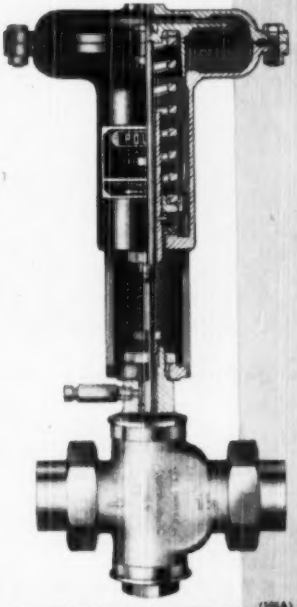
For Better Temperature and Humidity Control and valuable aid in selecting the right instruments for your requirements—phone or write our nearest office. There's no obligation. The Powers Regulator Co., 2737 Greenview Ave., Chicago 14, Ill. • 231 E. 46th St., New York 18, N.Y. • 1808 W. Eighth St., Los Angeles 5, Calif.

THE POWERS REGULATOR CO. • OFFICES IN 50 CITIES



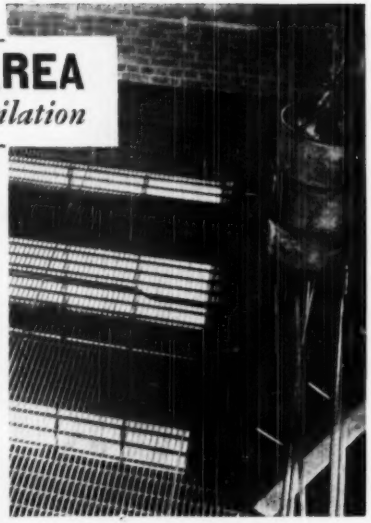
ABOVE: POWERS WET and DRY BULB RECORDING REGULATOR. Also available as a recorder only. Unit consists of two pen recording thermometer, water pan and motor blower causing sufficient circulation to give proper wet bulb readings.

ABOVE: POWERS TIME CYCLE RECORDING REGULATOR. Cam with cam follower operates steam control valve to correspond with any pre-determined time temperature schedule. Recording thermometer chart record provides a check on the operation of the control.



ABOVE: POWERS FLOWAY VALVE

90% OPEN AREA
for light and ventilation



THE illustration shows the admission of light through three floors where the flooring is Hendrick Mitco.

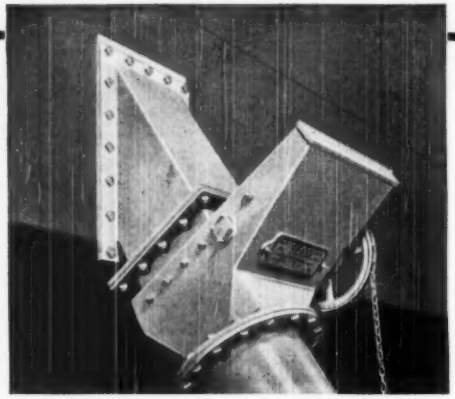
Not only does pressure-formed Hendrick Mitco Open Steel Flooring have 90% open area, but there are no bolts, rivets or angle irons to collect dirt and refuse. The square-edge, uniformly spaced, rectangular steel bars provide a non-slipping, level walking surface. There is no lateral deflection, however heavy the loading, because each Mitco panel is a strong, integral unit.

SEE OUR CATALOG IN SWEET'S

HENDRICK
Manufacturing Company

Perforated Metals
Perforated Metal Screens
Architectural Grilles
Mitco Open Steel Flooring,
"Shur-Site" Treads and
Armorgrids

46 DUNDAFF STREET, CARBONDALE, PENNA.
Sales Offices In Principal Cities



S-E-CO. COAL VALVES are equipped with a poke hole which enables operators to free coal that may stick at the bunker outlet. The poke hole also enables operators to inspect the inside of the valve. These poke holes are equipped with gasketed covers which make them dust-tight.

Write for bulletin.

STOCK ENGINEERING COMPANY
715P Hanna Building ★ Cleveland 15, Ohio

The glass indicating tube has a chemically inert synthetic packing ring for easy removal of the tube without breaking. Device can be used for measuring both pressure and vacuum.

King Engineering Corp, Box 100, Ann Arbor, Mich.

SOUNDPROOF BOOTH P386

High percentage of background noises from high-level noise areas can be effectively absorbed in a special wooden, soundproof booth for intercommunication systems.

Booth, lined with acoustic insulation board, is 13½ in. high, 13½ in. wide and 13½ in. deep.

Executone Inc, 415 Lexington Ave, New York 17, N. Y.

VARIABLE-SPEED UNIT P338

This unit consists of a control unit (where the incoming ac is changed to dc) a control station and a ¾, 1, 1½ or 2 hp dc motor. Speed range is 290 to 2300 rpm continuously and intermittently down to 80 rpm.

Printing presses, variable-flow pumps, centrifuges, etc, are a few of the applications for this variable-speed unit. Lower speeds may be had when unit is used with a gear motor.

Reliance Electric and Engineering Co, 1088 Ivanhoe Rd, Cleveland 10, Ohio.

PUMP BYPASS P321

When equipped with this balanced bypass, booster pumps on city-water supply deliver a constant volume at constant pressure regardless of variations in city water lines.

Eco Engineering Co, 12 New York Ave, Newark, N. J.

STOP VALVE P353

Figure 444 series stop valves are constructed of drop-forged steel and are available with bolted or union bonnets in sizes ¼ through 2 in., and with screwed or welding ends. Built of carbon or chromium molybdenum steel for two ranges of service conditions, they are rated for 600 psi at 900 F, and 1500 psi at 850 F, for steam, oil and gas service.

Swing-bolted packing glands and large

Over 1,000,000 NEW kw's from plants using KELLOGG power piping!

ONE million kilowatts of generating capacity require a whale of a lot of power piping. And when you reflect that this volume is confined solely to completed plants and not to piping supplied by Kellogg in the last 25 years, it takes on added significance.

But the actual volume is not so indicative as the reasons behind it. For example, most of these piping installations began on Kellogg's exclusive apparatus for determining stresses in piping layouts . . .

- . . . Two called for unusual experience in welding, for they were the first 1050° F. installations employing stainless steel . . .
- . . . Another required the fabrication of unique transition pieces in which two metals varying in thermal expansion by 50% were *Kelcaloyed* as single bi-metallic pieces with ends formed of different metals . . .
- . . . On several of the jobs availability of experienced supervisors for welding and stress relieving on the site was the key requirement . . .
- . . . And all of the installations reflected the results of extended study of such problems as graphitization, creep stress rupture that has been going on for years in Kellogg metallurgical laboratories.

Together these plants, eventually to provide more than one million kilowatts—and those of the past and future—indicate the extra value inherent in Kellogg's participation in the high temperature and pressure piping phase of power plant expansion and construction.

Special studies of unusual problems such as graphitization to assure long life and low maintenance.

Metallurgical research by recognized specialists who have made major contributions in this field.

Exclusive Equipment for accurately analyzing stresses in piping and providing unique data for critical installations.

Complete facilities for the fabrication of steel products from simple forgings to specially cast bi-metallic devices.

Top welding performance in shops and in the field by welders accustomed to working under X-Ray checks.

Quality control, devised by metallurgical experts, embracing forming, heat treating and non-destructive testing.

Vessels
Exchangers
Condensers
Process Piping
Forged and Welded Fittings
Radial Brick Chimneys

★

The M. W. Kellogg Company, Inc. (A Subsidiary of Pullman, Inc.) — Offices in New York, Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London and Paris.

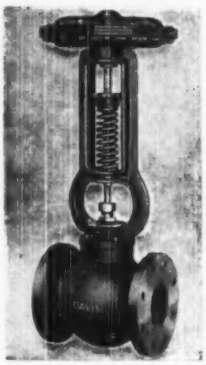
PRESSURE REGULATORS

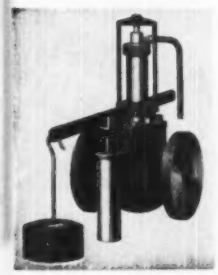
No. 13

(Left) Here is everything you need for good pressure regulation on small steam, air, or gas-operated units, compact, self-contained; built-in strainer. Parts accessible without disturbing piping. Tight closing, non-sticking single seat valve. Sizes ¼" to 2". For pressures to 250 p.s.i.; reduced pressures from 1 to 100 p.s.i.

No. 14

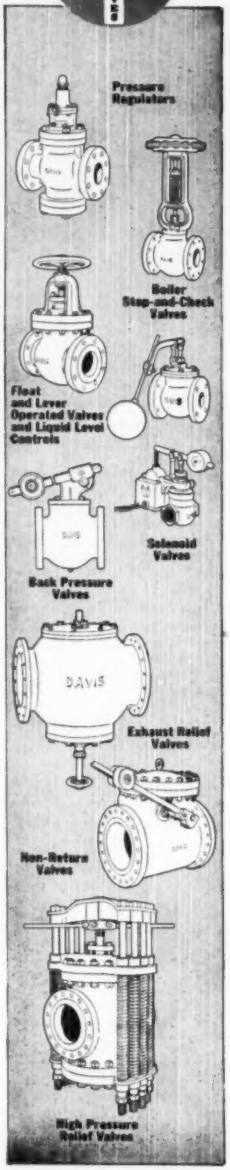
(Right) A direct connected, spring loaded pressure reducing valve designed for general industrial service on steam, air, gas, water, or oil. Features parabolic balanced disc construction with full port area. Immune to high pressure fluctuations. Control pressure to diaphragm chamber from reduced pressure line. Sizes ½" to 14". Screwed or flanged connections. Bronze, monel, or stainless steel trim. For pressures to 400 p.s.i.; any reduced pressure up to 200 p.s.i.





No. 2

(Left) Preferred by many engineers for smooth, dependable regulation of steam, air, or water pressure. Double seated, balanced, piston disc is unaffected by high pressure fluctuations. Counterweight and external oil dashpot make for close, accurate control on variable loads. For initial pressures to 600 p.s.i. and reduced pressures from 2 to 150 p.s.i. Sizes from ½" to 14".



The Davis Line of Pressure Regulators Is Complete!

• 18 different types to choose from; standard sizes up to 24" and for pressures up to 500 p.s.i. Davis recommendations are not biased by any favored types. As the job dictates, you are free to choose between direct or pilot control . . . spring or weight loading . . . piston or diaphragm action. You have your choice of the degree of the sensitivity needed for the job—you don't have to pay for more than you need. Ask for a copy of Davis Bulletin No. 100A. For recommendations, send complete information on your job.

DAVIS REGULATOR CO.

Representatives in All Principal Cities

2540 S. WASHTENAW AVE., CHICAGO 8, ILL.

packing chambers make repacking simple. Interchangeability of parts reduces maintenance inventories. Bronze yolk bushings prevent galling or freezing of stem.
Edward Valves, Inc, East Chicago, Ind.

VOLTAGE TESTER **P335**

New adaptation of *Mini-Volt* known as Model 410A, is accurate within 2 volts at 110-v ac. Glow-lamp indicator is guaranteed for 25,000-hr operation. Device can check voltage; tell whether ac or dc; check for continuity, blown fuses, grounds, etc. A new expanded scale is centered on the common 110- and 220-v points.
Industrial Devices Inc, Edgewater, N. J.

RESPIRATOR **P383**

Twin-cartridge respirator *No. R 5000* is designed to protect against (1) combination of all dusts (2) organic vapors (3) acid gases (4) combined acid and organic gases (5) ammonia (6) combination of organic vapors and all dusts and (7) metal fumes.

Device gives user one face piece for 7 interchangeable filters, which can be quickly screwed into the respirator's twin filter holders. Comes with one or more pairs of filters.

Face piece is molded from durable rubber and has a rolled edge curved inward to give snug fit without leakage.
American Optical Co, Southbridge, Mass.

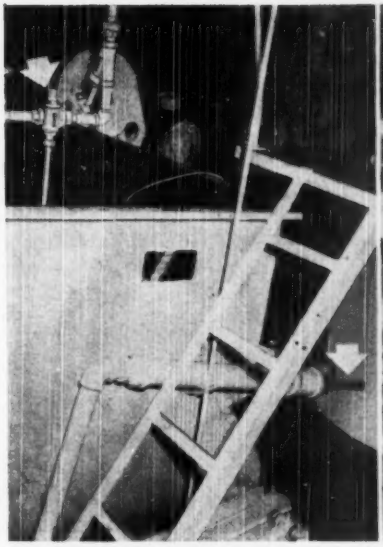
SHOCK ABSORBER **P314**

Compact liquid shock absorbers eliminate shock and hammering in pipelines and liquid systems. There are no moving metal parts. A rubber cushion, encased in a spherical metal chamber, absorbs the shock. This cushion pulsates constantly with changes in system pressure.
R-S Products Corp, Wayne Junction, Philadelphia 44, Pa.

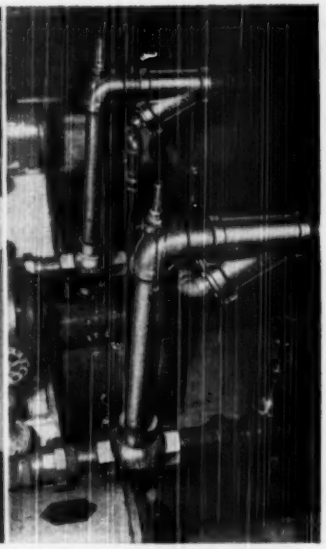
PNEUMATIC OPERATOR **P365**

A pneumatic power operator for valves, dampers and other control devices employs a reversible pneumatic motor and gear-driven screw stem. It combines the features of a self-locking stem and continu-

THE COST OF COLD



Sarco TR-21 on can cooling



Sarco Blenders on Diesel engines

It's human to play safe and "open her up wide" when cooling is done by hand control. But what is the cost of too much cold and more cooling water than you need?

In Process Cooling

The cooling hook up above handles forty No. 10 tins of syrups or foods per minute. It's a conveyor job with temperatures critical above sixty degrees. Formerly wide open, for safety, Sarco now opens or closes the valves down to a trickle as needed. Production is uninterrupted and absolutely uniform. Catalog No. 700.

In Refrigeration

Too much cold can be very expensive. For instance, it costs 15% more to cool milk to 37° than to 40°. Brine can be recirculated by the Sarco Blender shown at the right. No waste cold. Also ideal for defrosting, or any cooling operation. Catalog No. 700.

In Engines and Compressors

There is only one temperature of jacket water that will insure against overheating and give highest operating efficiency. At least ⅔ of the metered water was saved on a battery of compressors in Chicago by using Sarco, instead of wide open, "play it safe," hand control. Also water in hot well is now suitable for process work because its temperature is more uniform.

ASK FOR SARCO CATALOG No. 700 ON COOLING CONTROLS

This is the self contained, self acting control used for steam, water, brine and gas valves. No packing — no stuffing boxes. Pressures to 175 psi. Catalog No. 600.

SARCO BLENDER

A three way mixing valve that delivers liquids at constant temperatures regardless of pressures and temperatures in hot and cold supply lines. Catalog Nos. 700 and 800.

257

SARCO SAVES STEAM

SARCO COMPANY, INC.

Represented in Principal Cities

Empire State Building, New York 1, N. Y.

SARCO CANADA, LTD., TORONTO 5, ONTARIO

IMPROVES PRODUCT QUALITY AND OUTPUT

STOP STEAM WASTE

this simple way

CHECK LIST

- Steam Radiators
- Unit Heaters
- Pipe Coils
- Down-feed Risers
- Condensing Radiators
- Blast Coils
- Ends of Mains
- Cookers, Dryers
- Sterilizers
- Storage Water Heaters, etc.

HOFFMAN INVERTED BUCKET TRAPS

HOFFMAN RADIATOR TRAPS

HOFFMAN SUPPLY VALVES

HOFFMAN

Guardian of your Fuel and Comfort

HOFFMAN STEAM TRAPS

ously connected handwheel in a compact design.

Control can accurately position valve to within 1/500th part of stem travel; is sensitive to instrument changes as low as 0.025 psi; is good for stem loads up to 10,000 lb; stem travels up to 20 in; stem speeds up to 12 in. per min; and is suited to any type of heavy-duty throttling control application.

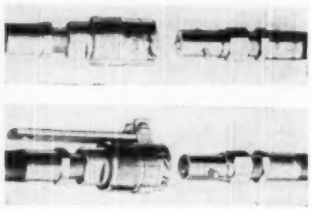
Conoflow Corp, 2100 Arch St, Philadelphia 3, Pa.

AUTOMATIC OILER P360

Automatic oil lubricator for slat conveyors that requires positive timing. Oil valve opens when the tripping mechanism is actuated by the wheels outside of slat conveyor. It remains open until closed by timer.

Timer setting allows a predetermined measured amount of oiled air to be injected into the wheel bearings. Timers are required on installations where the speed of the conveyor is slow; in this case only three feet per hour.

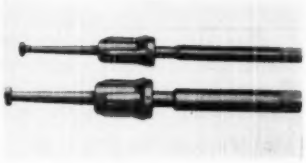
The J N Fauver Co, Inc, 49 West Hancock, Detroit 1, Mich.



HYDRAULIC COUPLER P308

Applicable to installations where a breakaway coupler is required and to those where a standard type is needed. When the plug is inserted in the socket a slight twist causes a sleeve to lock the coupler automatically. Standard coupler is disconnected by pulling the sleeve back. Used as a breakaway coupler the sleeve connects to the tractor by a bracket. When the mobile equipment breaks loose from the tractor the bracket pulls the sleeve back to disengage the coupler.

Ulrich Mfg Co, Roanoke, Ill.



TUBE EXPANDERS P302

Series 900 rolling and flaring tube expanders has been developed for installation and maintenance of superheater and small tubes in high- and low-pressure water-tube boilers.

To meet varying conditions, expanders are supplied with header mandrels 19 in. long, drum mandrels 12 in. long, and short mandrels 7 in. long. Universal joint drives

the HARD WAY

to solve your water conditioning problem —

Consider these factors: *Source of water*: Degree of hardness, alkalinity, turbidity, mineral and organic impurities, sludge forming characteristics, corrosiveness, seasonal variations, temperature ranges, etc. *Results required*: Degree of clarity, softness, alkalinity, residuals, stabilization, purity, taste and odor correction, iron removal, corrosion control, blended water, etc. *Method of treatment*: Water softener, chemical feed, concentration control, aeration, filtration, deconcentration, oil removal, pre-treatment, post-treatment, dealkalization, combination system, modernization of existing equipment, investment cost, etc. *Operating factors*: Cost, savings versus investment, operating skill required, critical limitations, plant balance, load factors, operating ranges, space requirements, etc.

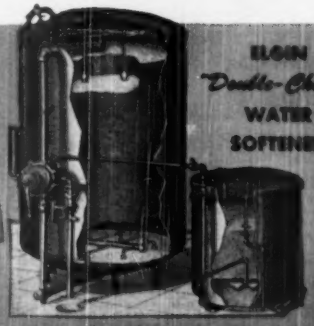
and the EASY WAY: *call on* ELGIN!

We show above just a partial listing of the factors that often must be considered in solving a water conditioning problem. Our purpose is not to worry you with complexities, but to show you how unsound it is to entrust your water conditioning problem to an organization that is limited in experience and in scope of methods and equipment.

Naturally if the organization is limited to zeolite softeners, the solution proposed to your problem will be zeolite softeners . . . if limited to chemical treatments, the proposed solution will be chemical treatments . . . and so on down the list.

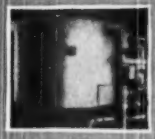
On the other hand, Elgin (utilizing all authoritative methods) is bound to no method but the *BEST*. For example, the most spectacular of all Elgin achievements is the dollar-saving Elgin "Double-Check" Softener described opposite . . . yet . . . you can't buy it unless an analysis of your condition convinces us that it is both the best and most economical solution of your water conditioning problem! And this holds true for every product in the Elgin line.

Yes, through Elgin you get the counsel of a firm that has seen enough conditions to *recognize* your needs; the counsel of a firm that is in a position to apply the method that exactly *suits* your needs. For a complete check-up of your requirements there is no cost or obligation whatever.



ELGIN "Double-Check" WATER SOFTENER

By preventing loss of zeolite the "Double-Check" design of the Elgin Softener permits a far larger bed of zeolite and utilizes it more efficiently. Result: 44% more soft water per regeneration than other softeners of same size using same type zeolite. "Double-Check" principle is also adaptable (at low cost) to your present softener of any make.

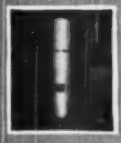


FILTERS — PURIFIERS

Elgin Water Filters and Purifiers for any filtration or purification requirement. Pressure Filters, with quartz or non-siliceous filtering medium, remove suspended impurities, including iron in suspension. Taste and Odor Removal Filters remove bad tastes and odors, including chlorine.

CHEMICAL FEED SYSTEMS

Many water conditioning problems are best and most economically solved by feeding the right chemical treatment in the right way. Elgin chemical treatments, individually formulated to meet specific conditions and properly fed by dependable Elgin chemical feeders, may prove to be the best answer to your needs.



DECONCENTRATORS

The Elgin Deconcentrator keeps boiler water clean—rids boiler of sludge, mud, and scale-forming matter — eliminates wasteful blowdown—cuts water treatment costs. Impurities are trapped in sedimentation chamber and eliminated in concentrated form.

ELGIN SOFTENER CORPORATION

130 North Grove Avenue

Elgin, Illinois

ELGIN ECONOMICAL WATER CONDITIONING

ASK FOR NEW BULLETIN 610 "ELGIN WATER CONDITIONING" GIVING FACTS YOU NEED.

SOFTENERS • CHEMICAL TREATMENT • FILTERS • BOILER WATER CONDITIONING

There's always room and big pay in POWER

Here's the information you need to equip yourself for a better job

Hundreds of men are using this practical library to reach the top in the power plant field. It brings you a complete education in power plant practice; it packs between the covers of 6 concise volumes a wealth of information on boilers, steam engines, steam turbines, pumps, boiler-feed apparatus, etc. Not only do you get the "how to" of every phase of power plant work, but this library gives you the fundamental principles in back of each phase and tells you "where," "when," and "why" a job should be done in a particular way

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By TERRELL CROFT

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4. Practical Heat—Part II
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are also available, and suitable for reaching through small hand or plug holes to operate the short mandrels. Bulletin No. 68 gives full details and specifications.
Gustav Wiedeke Co, Richard St, Dayton 1, Ohio.

SHUTOFF VALVE **P362**

Series 21 safety shutoff valve is designed to protect furnaces against dangerous accumulations of liquid or gas fuel in the event of power failure.

Valve stops fuel flow instantly when current to its solenoid is interrupted. When power is restored, valve remains closed until the trouble is corrected. Requires manual resetting. Valve can be had with all iron body and internals to withstand corrosive gases or liquids. Available in sizes from ¾ in. to 6 in., it can be equipped with solenoids of 110,220,440 volts and 60, 50 and 25 cycles.
The North American Manufacturing Co, 4455 East 71st St, Cleveland 5, Ohio.

MOTOR-CONTROL CENTER **P377**

Standardized control center containing motor starters for centralized control of groups of machines. Units feature plug-in disconnects on line side.

All units are 20 in. wide by 20 in. deep, with heights in multiples of 14 in. for interchangeability in standard indoor structures either 76 or 90⅜ in. high. Individual starter units are baffled from each other for added safety. Provision is made to vent hot ionized gases created by short circuits.
Westinghouse Electric Corp, Box 868, Pittsburgh 30, Pa.

CHEMICAL FEEDER **P369**

Feeder-Rator, made of transparent acrylic plastic, simultaneously controls, meters, and dispenses relatively small amounts of inhibitors and other chemicals into a larger stream.

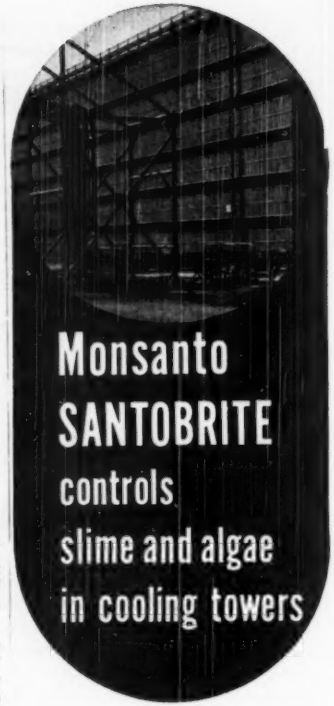
Built-in eductor takes the place of a pump so highly corrosive chemicals can be fed directly from a container. Unit will treat up to 7000 gal of water a day directly. In a bypass arrangement using 5% active reagent by weight, 5 ppm can be delivered to over 14,000,000 gal of water a day.
Fischer & Porter Co, Hatboro, Pa.

CLUTCH COUPLING **P378**

Designed for any shaft from ⅜ to 1¾ in. diameter, this automatic clutch-coupling can be adjusted on the job for different loads. Coupling comprises a motor and a driven half. A split, tapered bushing wedges the tapered coupling hub tightly to the shaft. Each coupling is a complete packaged unit ready for motors of 0.4 hp at 580 rpm to 25 hp at 1800 rpm.
Centric Clutch Co, 22-26 South Ave West, Cranford, N. J.

AIR OUTLET **P306**

Draftless air distribution plus regulation of air volume can be had in a single



Monsanto SANTOBRITE controls slime and algae in cooling towers

Slime and algae, enemies of good cooling tower operation, are kept under control by Santobrite (Monsanto's sodium pentachlorophenate, technical). Santobrite is economical...easy to use...efficient.

If slime and algae cause trouble in your cooling towers, it will pay you to read Monsanto Technical Bulletin No. O-15. For your copy, contact the nearest Monsanto Sales Office or write: MONSANTO CHEMICAL COMPANY, Desk A, 1763 South Second Street, St. Louis 4, Missouri.

Santobrite: Reg. U. S. Pat. Off.

DISTRICT SALES OFFICES: Birmingham, Boston, Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Seattle. In Canada, Monsanto (Canada) Ltd., Montreal.

MONSANTO
CHEMICALS — PLASTICS

SERVING INDUSTRY... WHICH SERVES MANKIND

This fan's job is a breeze... thanks to TIMKEN® bearings

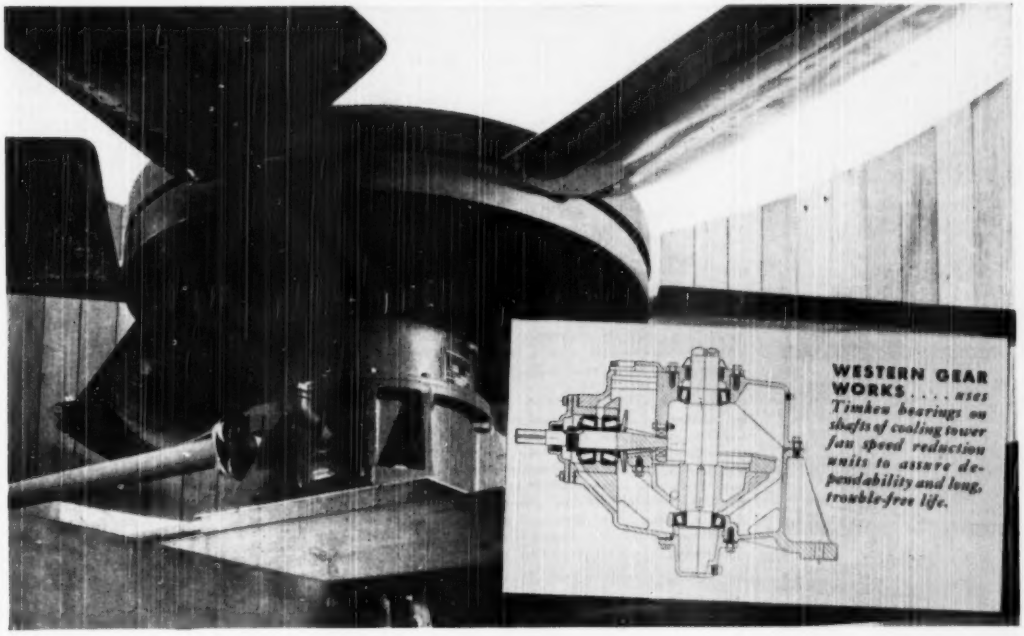
IF this 14' cooling tower fan assembly fails, it means a plant shutdown. Realizing this, the Western Gear Works, in co-operation with the Fluor Corporation, Ltd., developed a series of speed-reducing gear units expecially for cooling tower service. To assure ease of operation, dependability and long, trouble-free life, Western Gear Works specified Timken® bearings.

Even under the toughest loads, Timken tapered roller bearings hold shafts in positive alignment. Gears mesh with constant precision and wear is minimized. Due to the tapered construction of Timken bearings, any combination of radial and thrust loads is carried with minimum deflection and end-play. Timken bearings permit tighter closures which effectively retain lubricants and keep out damaging dirt and moisture.

Full line contact between the rolls and races provides maximum load-carrying capacity. Manufactured to incredible precision and finished to amazing smoothness, Timken bearings practically eliminate friction. And since they are made of the finest alloy steel ever developed for tapered roller bearings—Timken fine alloy steel—they normally last the life of the machine.

No other bearing offers *all* the advantages you get with Timken bearings—backed by fifty years of bearing research and development. Make certain that Timken bearings are in every machine you buy or build. And look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.


WESTERN GEAR WORKS . . . uses Timken bearings on shafts of cooling tower fan speed reduction units to assure dependability and long, trouble-free life.

DESIGN LEADERSHIP

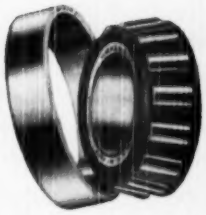
The first Timken tapered roller bearing was produced in 1898. Since then the one-piece multiple perforated cage, wide area contact between roll ends and ribs, and every other important tapered roller bearing improvement have been introduced by The Timken Roller Bearing Company.

The Timken Company leads in: 1. advanced design; 2. precision manufacture; 3. rigid quality control; 4. special analysis steels.

TIMKEN

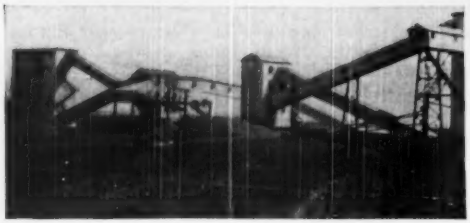
TRADE MARK REG. U.S. PAT. OFF.

TAPERED ROLLER BEARINGS

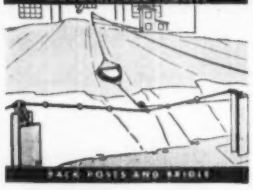


NOT JUST A BALL ○ NOT JUST A ROLLER ⊂⊃ THE TIMKEN TAPERED ROLLER ⊂⊃ BEARING TAKES RADIAL ⇩ AND THRUST →⇩← LOADS OR ANY COMBINATION →⇩←

SAUERMAN FOR FAST MATERIAL HANDLING AT LOWEST COST



Operating since 1928, this Sauerman Power Drag Scraper has stored and reclaimed over 3 million tons of coal and still is good as new . . . . .



4 TYPES OF SAUERMAN DRAG SCRAPER UNITS

The Sauerman scraper installation pictured above has 22 years of service behind it and seems ready for many more. It operates on a dock 1,000 ft. long and 400 ft. wide adjoining an industrial plant that consumes about 450 tons of coal a day. The scraper spreads and stacks the coal brought in by cargo ships and reclaims as required to a receiving hopper near the plant.

Maintenance About 3/10¢ for Each Ton of Coal Handled

Analysis of the company's cost sheets for a period of several years shows an average maintenance expense, in round figures, of $1100 a year. In terms of tonnage handled, repairs actually amounted to $.0032 for each ton of coal stockpiled and each ton reclaimed. Total direct operating expense, including maintenance, averaged a slight fraction over 5 cents a ton for the complete operation of storing and reclaiming.

The above record of low operating expense and particularly low maintenance expense is typical of what to expect from a Sauerman machine. But this is only one of the reasons for its widespread use. It reduces labor and management problems because it is mechanically simple and its operation is an easy, comfortable one-man job. It builds a pile in compact layers, leaving no voids to cause spontaneous combustion. Flexibility is another of its advantages; a Sauerman installation can be extended readily or adapted to meet changes in capacity requirements.

Repeat Orders Tell the Story

Considering all of the advantages offered by this modern method of storing and reclaiming coal, is it any wonder that satisfied users recommend this equipment to others and make additional installations of Sauerman Power Drag Scrapers when they build or acquire new plants. A large percentage of the orders for Sauerman machines in recent years come from firms already operating one or more of these scraper installations.

In our 41 years of service to industry we have supplied plans and equipment for coal storage to many of the largest industrial firms, public utilities and mines. Write us about your storage problem and we will give you our recommendations on equipment and a copy of our catalog without obligation on your part.

SAUERMAN BROS., Inc.
562 SO. CLINTON ST. CHICAGO 7, ILLINOIS

unit, the *Uni-Flo* grille, with an integral volume control.

Tamper-proof adjustments are accessible from the grille face for any required changes in air volume or direction. The grilles have removable cores to allow for repair work, or cleaning and redecoration without damage to wall surface.

Barber Colman Co, Rockford, Ill.

SHAFT PACKING P385

Chemiseal No. 711 packing is made with alternative rings or solid, unoriented *Teflon* and of graphite or mica combined with *Teflon*. Packing is noncorroding and noncontaminating.

Material is particularly adapted to applications where chemical attack from solvents, acid or alkalis or contamination of the product is a serious problem. Natural lubricating properties of the graphite and *Teflon* make any additional lubricant unnecessary in many applications.

United States Gasket Co, 602 North 10th St, Camden, N. J.

OXYACETYLENE OUTFIT P366

Packaged oxyacetylene welding and cutting outfit, *Flamecraft*, has oxygen and acetylene cylinders, welding torch, cutting attachment, tips, regulators, hose, goggles, cylinder truck, fluxes, assortment of welding and hard facing rods, and instruction folder.

Cylinders are the 60-ft acetylene and 122-ft oxygen ones recently announced. They are supplied on a 25-yr lease basis. This arrangement eliminates demurrage charges and guarantees cylinder maintenance.

Air Reduction Sales Co, 60 East 42nd St, New York 17, N. Y.

LAMP-DISPOSAL UNIT P336

Recent beryllium scare prompted design of this machine that safely disposes of burnt-out fluorescent tubes. But, regardless of that, it is a good rig for getting rid of a nuisance. Small motor-operated unit grinds old lamps safely under water.

Device handles about 100 lamps in 10 min. Refuse can be carried away in a bucket. Unit operates on 12-gal water and 110 v.

Laduby Co, PO Box 1123, New Haven 5, Conn.

AUTOMATIC MANOMETER P343

Levlocator reads liquid height to 1/100 of an in. It precisely determines the height of a liquid column, and indicates this height at a local or remote station.

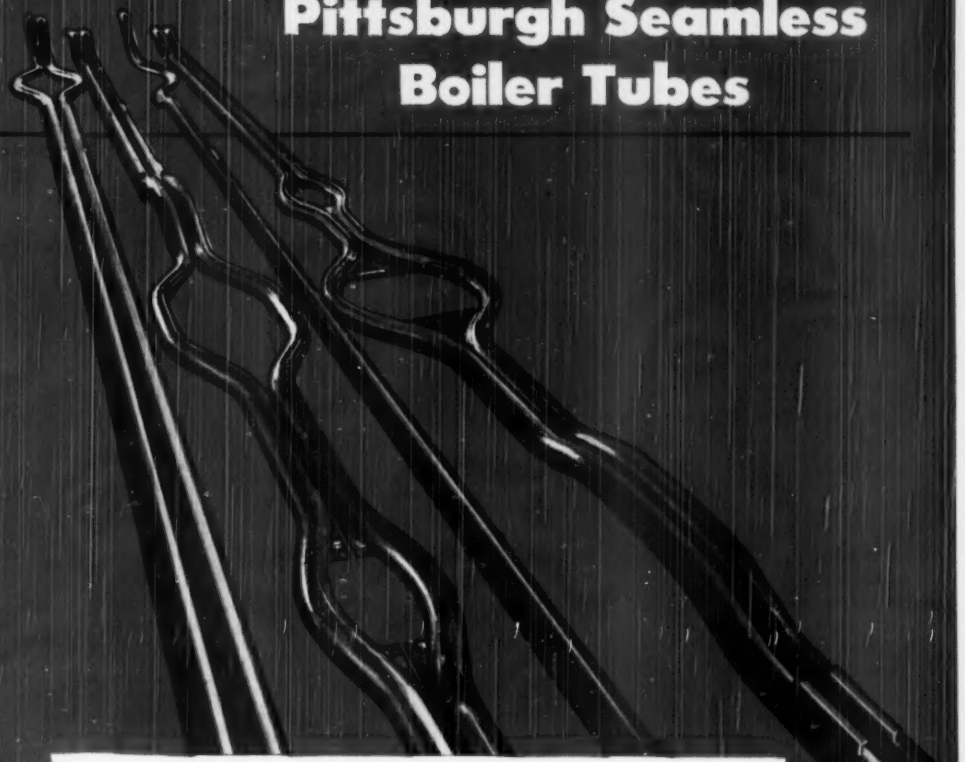
Device can be furnished with any practical-height manometer tube constructed of materials for extreme pressures. Operation is by electronic finder, and the instrument can be used for reading pressure, vacuum, differential pressure, as a sensitive flowmeter and a draft gage.

Asch Equipment Co, 98-11 Queens Blvd, Forest Hills, N. Y.

(*Continued on page* 190)

You Get Extra Service With...

Pittsburgh Seamless Boiler Tubes



YOU GET EXTRA SERVICE with Pittsburgh Seamless Boiler tubes for they have the inherent quality to assure dependable, economical operation at high pressures and high temperatures. The steel is sound, homogenous, and the chemistry closely controlled to provide the tensile strength for safety, the ductility for easy fabrication, the size accuracy for fast installation. All combine to give you extra service. Specify Pittsburgh Seamless Boiler Tubes every time.

Pittsburgh Steel Company

Grant Building · Pittsburgh 30, Pa.

Another Installation Of

For Efficient Steam Production

Bigelow Type F and FH water tube boilers are designed and built to give you efficient and economical steam production.

The baffles are arranged to assure maximum heat pick up which means lower stack temperatures. The rear passes are baffled so that the cross section area is restricted, compensating for the decreased volume of the partially cooled gases.

Bigelow Type F and FH boilers are available in capacities from 20,000 to 100,000 pounds of steam per hour. Design pressures range from 160 to 450 lbs. p.s.i. These boilers are designed for oil, coal or gas firing.

For further information, write for Bigelow's catalog or contact your nearest Bigelow representative.

THE BIGELOW COMPANY · NEW HAVEN 3, CONN.

ESTABLISHED 1833

BIGELOW REPRESENTATIVES: Boston · New York · Philadelphia · Syracuse · Detroit · Chicago · Pittsburgh · Milwaukee · New Orleans · Baltimore · Petersburg, Va. · Washington, D. C. · Albuquerque · Seattle · Sumter, S. C.

BI-1

BOILERS BY BIGELOW

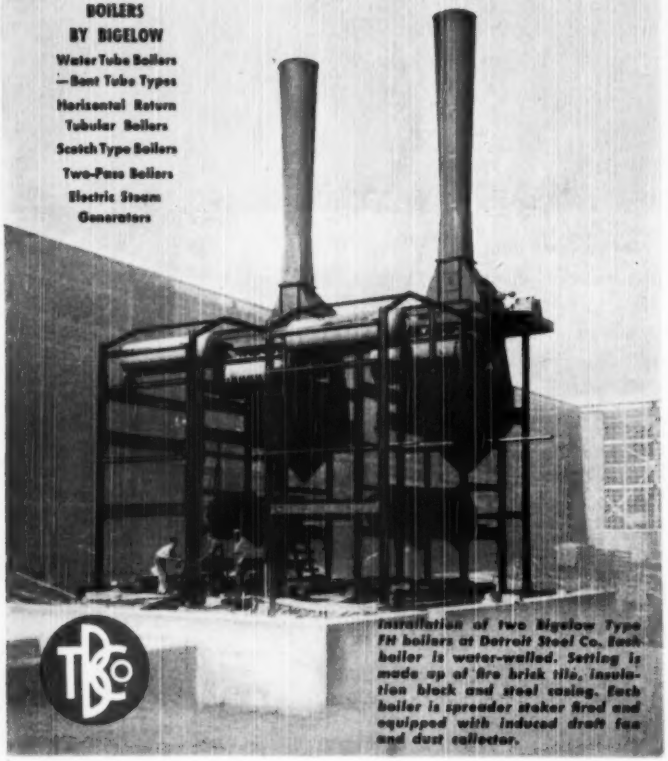
Water Tube Boilers —Bent Tube Types

Horizontal Return Tubular Boilers

Scotch Type Boilers

Two-Pass Boilers

Electric Steam Generators

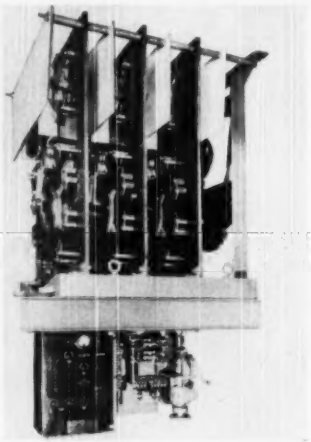


Installation of two Bigelow Type FH boilers at Detroit Steel Co. Each boiler is water-walled. Setting is made up of fire brick tile, insulation block and steel casing. Each boiler is spreader stoker fired and equipped with induced draft fan and dust collector.

HEAT METER **P303**

Special calculating dial, *Heat-O-meter*, measures radiation on steam and hot-water heating systems. Dial contains scales of storage-tank dimensions and capacities, sq ft of radiation per sq ft of glass, sq ft radiation per radiator section, red hot-water boiler ratings for coal. Manufacturer says it eliminates tedious figuring.

Heat-O-meter Co, 424 W 42nd St, New York 18, N. Y.

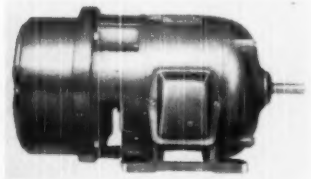


TAP-CHANGER **P375**

Designed for tap changing under load, this equipment provides a voltage-regulation range of 20% in thirty-two $\frac{5}{8}$-percents steps. Device incorporates a new principle in reactor switching along with eliminating arcing duty from the tap selector switch.

Tap-changer has increased interrupting capacity in addition to combined spring-accelerated and direct-drive load switching. Load-tap changer shown above is rated for 34.5 kv, giving $\pm$ 10% regulation on transformers rated up to 35,000 kva. Mechanisms for 15 kv are also available.

Moloney Electric Co, St. Louis, Mo.



MOTOR AND BRAKE **P324**

Units offer compactness and simplicity for loads requiring frequent quick stopping and starting. This brake motor has prelubricated for life anti-friction bearings and a brake lining that eliminates the need for adjustments. Brake can be mounted on dripproof splashproof or totally-enclosed 1- to 60-hp motors. Brake has bonded metal linings, not effected by heat, cold, dampness, salt water, fungi,

(*Continued on page* 200)

PLANT EQUIPMENT NEWS

Reader Service Page for New Products and Literature

Use the handy FREE service cards for additional information on this month's new products or for copies of latest trade catalogs.

AIR CONDITIONING, HEATING, REFRIGERATION AND VENTILATION

A19 **CONTROLLED HUMIDITY** — Niagara Blower Co, 405 Lexington Ave, New York 17, N. Y. Single-sheet No. 113 describes Niagara's controlled-humidity method of air conditioning. Flow diagram is given.

A20 **COOLING EQUIPMENT**—Frick Co, Waynesboro, Pa. 8-page booklet illustrates and gives a check list of typical Frick equipment for refrigerating, ice making and air conditioning.

BOILERS AND AUXILIARIES

B28 **WATER-TUBE BOILERS** — Henry Vogt Machine Co, 1000 W. Ormsby St, Louisville 10, Ky. 16-page catalog features the Vogt Class VL water-tube boilers. Contains diagrams and principal data of several units installed in power plants.

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

★ **STEAM BOILERS** — Cleaver-Brooks Co, 3384 E Keefe Ave, Milwaukee, Wis. 12-page publication points out advantages of self-contained, oil- and gas-fired steam boilers for processing and heating. Illustrated are various sizes ranging from 15 to 500 hp and 15 to 200 hp.

B29 **DUST COLLECTORS** — Pratt-Daniel Corp, East Port Chester, Conn. 16-page booklet No. 1508 provides detailed information on the new Velmont Type S dust collector and the standard Type HC. A nomograph chart is included for determining number of tubes required for a given capacity, temperature and resistance.

B30 **PACKAGED STEAM BOILERS** —Edge Moor Iron Works, Inc, Edge Moor, Del. 8-page folder No. G-421 discusses Edge Moor power Gems steam generator, a fully packaged unit including all necessary equipment. Specifications are given for all models of standard boiler equipment and standard burner equipment for heavy oil.

B31 **SOOT-BLOWING SYSTEMS** — Vulcan Soot Blower Corp, Dubois, Pa. 16-page bulletin No. 488 describes Vulcan automatic-sequential power-operated soot-blowing systems. Operating procedures are discussed in detail, and 10 typical installations are shown diagrammatically.

CONTROLS, MECHANICAL

E14 **HYDRAULIC CYLINDERS** — Vickers Inc, 1400 Oakman Blvd, Detroit 32, Mich. 32-page booklet No. 49-55 presents a wide variety of styles and sizes of Vickers hydraulic (oil) cylinders. Also contains engineering data, illustrations and dimension tables.

E15 **COMBUSTION CONTROL** — Ess Instrument Co, Bergenfield, N. J. 4-page leaflet No. 802 tells about Ess Hazegage "electric eye" combustion control, an automatic control especially adapted for use with oil burners, particularly those of the rotary cup type.

(*Continued on page 190b*)

HOW TO ORDER ADDITIONAL DATA

Be sure to fill out, completely, one coupon for each item of information you order. (See sample, right.) This gives your request authority and helps the manufacturer to address your copy completely.

When you have filled out completely one space for each item of information you want, detach along the scored lines and drop the cards in the mail.

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ELECTRICAL EQUIPMENT

F51 SYNCHRONOUS MOTORS — General Electric Co, Schenectady 5, N. Y. 8-page booklet No. GEA-5421 illustrates and gives informative data on Tri-Clad high-speed synchronous motors. Covered are Type TS (3-phase) and Type QS (2-phase) motors. A list of applications is included.

F52 LARGE DC GENERATORS — Allis-Chalmers Mfg Co, 912 S 70th St, Milwaukee, Wis. 24-page catalog No. O6B7128 shows Allis-Chalmers large dc generators. It contains construction details of units larger than 150 kw, or 0.3 kw per rpm. These include 3- and 3-wire generators and exciters, both engine and coupled type.

F53 ELECTRICAL CONDUITS—National Electric Products Corp, Chamber of Commerce Bldg, Pittsburgh 19, Pa. 16-page book No. 681 describes and illustrates the many types of electrical conduits manufactured by National Electric.

F54 SYNCHRONOUS GENERATORS —General Electric Co, Schenectady 5, N. Y. 8-page publication No. GEA-5416 deals with Tri-Clad high-speed synchronous generators for standby, portable, and prime-source power in wide-spread fields of application.

F55 GENERAL-PURPOSE ELECTRIC MOTOR—Sterling Electric Motors, Los Angeles 22, Calif. 4-page leaflet No. 161A features the Sterling Klood general-purpose electric motor for use where one best constant-normal speed is required.

HEAT EXCHANGERS

G3 OIL AND WATER COOLERS — Condenser Service & Engrg Co, Seaboard Trust Bldg, Hoboken, N. J. 28-page bulletin, entitled "Type AL Coolers," contains an engineering section and gives materials of construction on Conseco Type AL lube oil and jacket watercoolers.

G4 WATER HEATER—Davis Engrg Corp, 1004 E Grand St, Elizabeth, N. J. 4-page folder No. 190 covers application, design features and advantages of automatic self-cleaning White water heater.

G5 STEAM-JET AIR EJECTORS — Condenser Service & Engrg Co, Seaboard Trust Bldg, Hoboken, N. J. 8-page booklet discusses Conseco steam-jet air ejectors for modern, efficient, low-cost air removal from condensers. Principle of operation and engineering data are included.

MAINTENANCE AND SAFETY EQUIPMENT

K18 LEAK DETECTOR — Consolidated Engrg Corp, 816 N Lake Ave, Pasadena 4, Calif. 16-page catalog No. CEC-1501B describes operation, performance, and features of the Consolidated leak detector. A section is devoted to applications and leak-detection methods used in both vacuum and pressure systems.

K19 VERNIER CALIPER — George Scherr Co, 200F LaFayette St, New York 12, N. Y. 2-page leaflet tells about the new Mauser vernier caliper for outside, inside and depth measurements.

K20 COAL-DUST CONTROL—Aquadyne Corp, 320 E 42nd St, New York 17, N. Y. 4-page folder, entitled "Coal Dust Control," discusses the Aquadyne "wet water" system and its application in coal-dust control.

K21 SHAPERS — Cincinnati Shaper Co, Cincinnati 25, Ohio. 12-page bulletin No. N-5 illustrates and describes the Cincinnati line of shapers. Dimensions and specifications of each type are given.

K22 ACID-PROOF DRAINS — Duriron Co, Dayton 1, Ohio. 12-page price list No. H-2 illustrates all Duriron acid-proof drain-line equipment available for handling corrosive wastes from chemical laboratories, engraving shops, chemical plants, plating rooms, steel mills and many other places. Typical installations are listed.

MAINTENANCE MATERIALS

L36 VACUUM HOSE—B F Goodrich Co, Akron, Ohio. 4-page folder No. 4740 pictures and describes industrial vacuum hose, which handles dust, abrasive scrap and toxic fumes in many industries. Construction details, recommended uses and specifications are given.

L37 CAST SPROCKETS—Chain Belt Co, 1600 W Bruce St, Milwaukee 4, Wis. 16-page catalog No. 49-50 covers Rex stock-size cast sprockets for the complete line of Rex drive and conveyor chains. Dimensions, specifications, list prices, sprocket style and all other necessary information are included.

L38 ANTI-PRECIPITATING AGENTS — H F Drew & Co, Power Chemicals Div, 15 E 26th St, New York 10, N. Y. 4-page technical bulletin tells about the use of anti-precipitating agents for the prevention of scale, deposits and corrosion in cooling systems, service water lines, heat exchangers and other process equipment.

L39 CHEMICAL RESISTANT COATINGS—Wilbur & Williams Co, Greenleaf & Leon Sts, Boston 15, Mass. 4-page folder contains valuable information on applications for maximum chemical, moisture and rust resistance in varied industries for all metal, concrete and wood.

L40 SHEET PACKING—B F Goodrich Co, Akron, Ohio. 4-page publication No. 5000 lists specifications and outlines uses of the different kinds of sheet packing that the company manufactures for handling liquids, gases and abrasives.

MATERIALS HANDLING

M27 HEAVY-DUTY SCALPER — Robins Conveyors Div, Hewitt-Robins Inc, 270 Passaic Ave, Passaic, N. J. 4-page bulletin No. 121 describes and illustrates an unusual vibrating machine able to scalp-off huge lumps of solid rock as big as 5x5x5-ft and weighing 1½ tons or more per piece.

M28 GRAIN PROCESSING — Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill. 20-page book No. 2305 shows and briefly describes materials-handling and power-transmission equipment that the company most commonly supplies to grain and allied processing industries for efficient, low-cost operation.

MECHANICAL TRANSMISSION

N18 VARIABLE-SPEED DRIVE — Reeves Pulley Co, Columbus, Ind. 8-page folder No. M-4917 discusses Reeves vari-speed Motodrive. General

(*Continued on page 192*)

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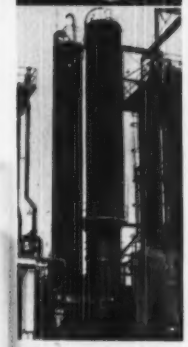

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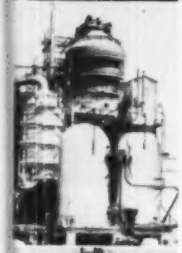

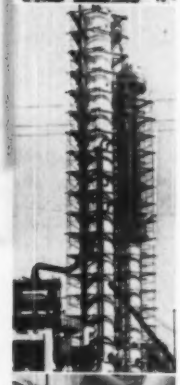

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characteristics, diagrams of vertical and horizontal assemblies without reducer, with single reducer, or with double and triple reducers, and specification tables with list prices are given.

N19 **ROLLER CHAINS**—Chain Belt Co, 1600 W Bruce St, Milwaukee 4, Wis. 24-page book No. 49-2 discusses the broad application of roller chain by means of a representative showing of very unusual applications.

N20 **SPEED REDUCERS** — Falk Corp, 3001 W Canal St, Milwaukee 8, Wis. Bulletin No. 1110 provides complete engineering data on Falk parallel-shaft sleeve-bearings speed reducers in handy easy-to-read form.

N21 **TRANSMISSION BELTING** — B F Goodrich Co, Akron, Ohio. 4-page catalog section No. 2100 pictures and describes various types of rubber transmission belting. Recommended uses are listed and specifications given.

N22 **CLUTCH COUPLING** — Centric Clutch Co, 22-26 South Ave West, Cranford, N. J. Single-sheet bulletin No. T-649 features Rawson clutch coupling with taper bushings. Dimension and rating tables are included.

METALS AND ALLOYS

R15 **BRONZE BARS** — National Bearing Div, American Brake Shoe Co, 4930 Manchester Ave, St. Louis 10, Mo. 6-page folder covers the company's expanded line of cored and solid Tiger bronze bars in all popular sizes, both rough and machined.

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

★ **FERROUS METALLURGY** — Tempil Corp, 132 W 22nd St, New York 11, N. Y. Chart, entitled "Basic Guide to Ferrous Metallurgy," shows the working characteristics of steels in temperatures from minus 300 F to 2900 F. All important temperature zones for welding are clearly defined.

R16 **COPPER-BASE DIE ALLOYS**—Ampco Metal Inc, 1745 S 38th St, Milwaukee 4, Wis. 4-page article, entitled "Copper-Base Die Alloys," describes advantages, how best results are secured, producing, preparing and machining of such dies.

METERS AND INSTRUMENTS, ELECTRIC

S6 **METER ELEMENTS** — Marion Electrical Instrument Co, Manchester, N. H. 12-page pamphlet discusses elements of Marion ruggedized electrical indicating instruments. Diagrams are included.

S7 **INSULATION TESTERS** — James G Biddle Co, 1316 Arch St, Philadelphia 7, Pa. 8-page bulletin No. 21-46 gives informative data on rectifier and dual-operated models of the Meg Type of Megger insulation testers. Applications and specifications are listed.

METERS AND INSTRUMENTS, MECHANICAL

T25 **COMPENSATING FLOWMETER** —Hagan Corp, Hagan Bldg, Pittsburgh 30, Pa. 4-page folder No. M-51 explains how automatic compensation for pressure or temperature variations, or for both, are achieved in flow measurement of gases, liquids or other fluids with the Hagan compensated Ring-Balance meters.

T26 **FLOW GAGE**—Fischer & Porter Co, Hatboro, Pa. 4-page catalog No. 96 presents completely redesigned Magna-Sight flow gage, a simple, low-cost flow-rate indicator for coolants, lubricants, opaque liquids, slurries and other fluids. Design, operation and installation data are given.

T27 **LIQUID-LEVEL INDICATOR**—Asch Equipment Co, 98-11 Queens Blvd, Forest Hills, N. Y. 4-page

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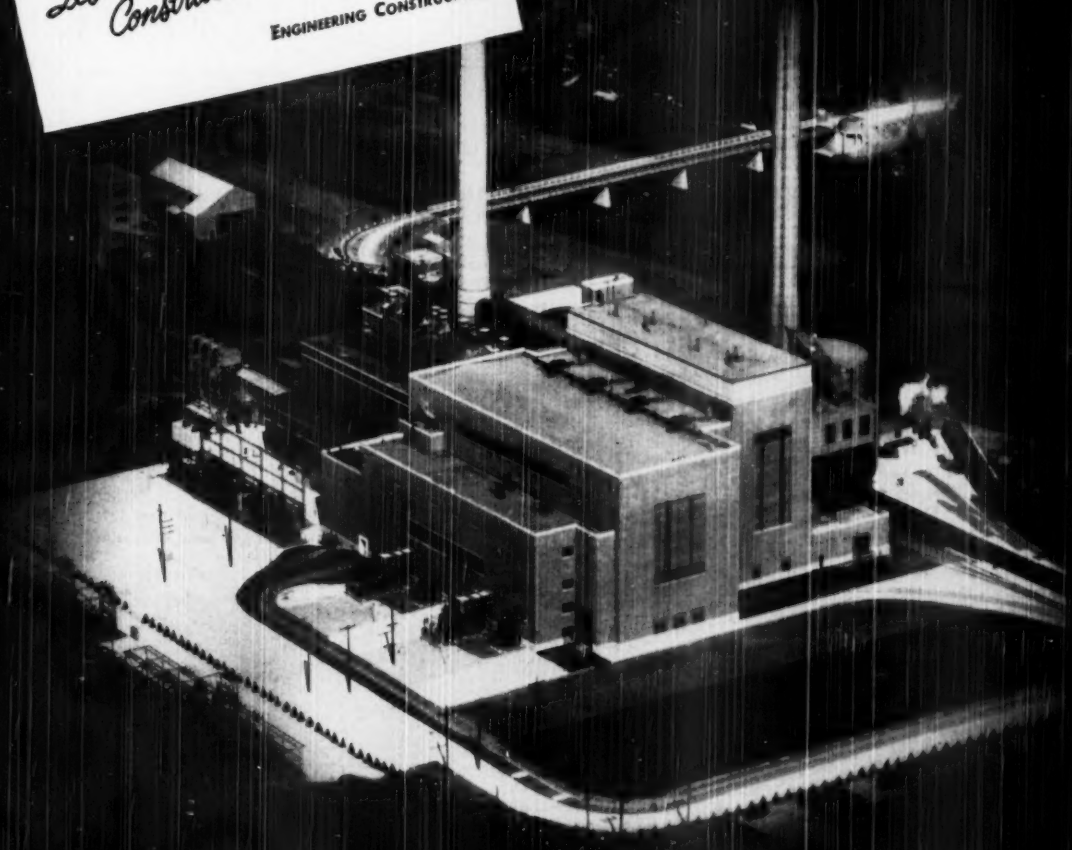

PHILADELPHIA ELECTRIC COMPANY'S 180,000 kw power station at Barbadoes Island, Norristown, Pennsylvania. The additional facilities recently constructed by the Power Department of Dravo Corporation more than triple the capacity of the original station.

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SKINNER "UNIVERSAL UNAFLOW" STEAM ENGINES

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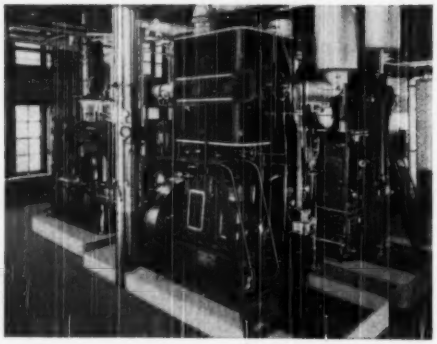

Two 2-cylinder Skinner Vertical "Universal Unaflow" Steam Engines driving two 400-ton ammonia compressors.

The Burger Brewing Company has the largest single-plant brewery in the state of Ohio. Established in 1874, Burger brews and slogan have become famous from coast to coast. The huge new bottle shop building and additions to brewing equipment have brought its capacity to more than one million barrels annually.

Two new Skinner "Universal Unaflow" Vertical Steam Engines drive two 400-ton variable-speed ammonia compressors. A floor space of only 15 x 25 feet is required for this compact dual engine and compressor installation.

Skinner "Universal Unaflow" Engines were chosen for this new installation, on the basis of the highly successful performance of two horizontal "Universal Unaflow" Steam Engines which have been Burger's chief source of electric power for many years. Exhaust steam from the four engines is used for generating all hot water, including pasteurization and boiler feed, and for brew and space heating.

Skinner "Universal Unaflow" Engines have long been popular for brewery service. They are also providing dependable, economical power for thousands of other processing and manufacturing plants, office buildings, hotels, schools, hospitals and other institutions. Write for detailed information on the advantages of Skinner "Universal Unaflow" Steam Engines in your field.

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pamphlet No. 102 features the Leviocator, an instrument for improved process and inventory control of stored liquids.

PIPING, FITTINGS, VALVES AND SPECIALTIES

U38 **AUTOMATIC VALVE SPECIALTIES** — Davis Regulator Co, 2541 S Washtenaw Ave, Chicago, Ill. 72-page catalog No. A-50 contains informative data and price lists on Davis valve specialties including pressure regulators; altitude valve; pump governors; lever, float and motor-operated valves; pilot, backpressure, relief, nonreturn and solenoid valves; steam trap and air vent; and liquid-level controllers.

U39 **MOISTURE SEPARATORS** — Swartwout Co, 18511 Euclid Ave, Cleveland 12, Ohio. 12-page bulletin S-14-C covers the company's complete line of separators for removing unwanted elements from steam, air and other vapors. Photographs, specifications, selection and ordering data are given.

U40 **STOP VALVES**—Edward Valves Inc, East Chicago, Ind. 4-page folder No. 501 describes in detail the new Edward Fig. 444 series forged-steel globe and angle stop valves, which can be had with either bolted or union bonnets, and with either screwed or socket welding ends. Also gives list prices.

PRIME MOVERS AND ACCESSORIES

V13 **DIESEL ENGINES** — Cummins Engine Co, Columbus, Ind. Two bulletins, No. 5285 (NHS-600) and No. 5290 (NHRS-600), contain complete specifications for automotive and industrial models of two supercharged, 6-cylinder Cummins diesels, the 275-hp (maximum) NHS engine and the 300-hp (maximum) NHRS engine.

V14 **STEAM CONDENSERS** — Condenser Service & Engrg Co, 95 River St, Hoboken, N. J. 28-page catalog No. 441-C gives informative data on Conseco condensers. Illustrations show installations of various models. A pressure-temperature conversion table is also included.

V15 **HIGH-SPEED DIESELS** — Cummins Engine Co, Columbus, Ind. Booklet No. 5218C describes 68 high-speed diesels for automotive, industrial and marine applications, covering the entire power range from 50 to 550 hp, and three medium-speed diesels. Each engine is pictured with a listing of standard equipment and notations on optional equipment that can be supplied.

PUMPS

W28 **BLADELESS IMPELLER PUMP** — Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago 5, Ill. 16-page bulletin No. 5400K-1 consists of construction data, principal dimensions, performance data, and selection tables for the Fairbanks-Morse bladeless sewage and trash pump.

W29 **HYDRAULIC PUMPS** — Vickers Inc, 1400 Oakman Blvd, Detroit 32, Mich. 48-page catalog No. 4900 describes the more widely used Vickers hydraulic pumps and controls that are adapted to industrial machinery. Contains illustrations of various units.

W30 **VACUUM PUMPS**—Kinney Mfg Co, 3529-41 Washington St, Boston 30, Mass. 6-page article tells about use of mechanical vacuum pumps in central-station operation. Diagrammatic sketches and charts are included.

W31 **CENTRIFUGAL AND PISTON PUMPS**—Condenser Service & Engrg Co, Scranton Pump Div, 1445 Meylert Ave, Scranton, Pa. 24-page bulletin No. L discusses Conseco centrifugal and piston pumps. Operating data, applications and construction features of several illustrated types are given.

WATER TREATMENT

X12 **pH AND CHLORINE CONTROL** —W A Taylor & Co, 7300 York Rd, Baltimore 4, Md. Handbook, entitled "Modern pH and Chlorine Control," describes the complete line of Taylor com-

CONDENSER VACUUM

at your fingertips

In modern high pressure steam generating stations, Kinney Rotary Vacuum Pumps are paying new dividends in efficiency and economy. The mechanical vacuum pump is like any other motor driven unit. It gives you complete start-and-stop control right at your fingertips — right at the central control panel. No longer is it necessary to "horse" with big reducing valves — always a maintenance headache when "hogging jets" are used.

The positive displacement Kinney Pump provides full condenser vacuum control over the complete range of pressures from atmospheric down to a fraction of an inch Hg. abs. It sweeps out ammonia, carbon dioxide, and other corrosive gases — instead of concentrating them. And the Kinney Rotary Vacuum Pump now makes possible the ideal piping layout: a single steam line from boiler to turbine.

When designing for steam pressures in excess of 1000 psi, it's wise to consider the tested and proven economies that only mechanical vacuum pumps can give. Profit by the experience of other modern steam generating stations — install Kinney Vacuum Pumps.

Kinney Manufacturing Company, 3532 Washington St., Boston 30, Mass. Representatives in New York, Chicago, Cleveland, Houston, New Orleans, Philadelphia, Los Angeles, San Francisco, Seattle. Foreign Representatives: General Engineering Co. (Radcliffe) Ltd., Station Works, Bury Road, Radcliffe, Lancashire, England . . . Horrocks, Roxburgh, Pty., Ltd., Melbourne, C. I. Australia . . . W. S. Thomas & Taylor Pty., Ltd., Johannesburg, Union of South Africa . . . Novelectric, Ltd., Zurich, Switzerland.

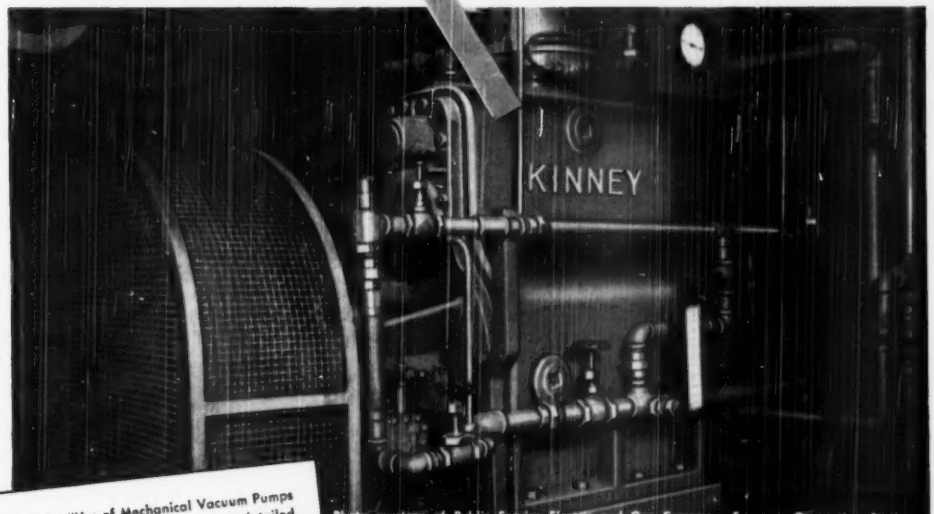

Photo courtesy of Public Service Electric and Gas Company, Sewaren Generating Station

Send for "Use of Mechanical Vacuum Pumps in Central Station Operation" — a detailed engineering report including actual installation drawings. Also Kinney Bulletin V-45, the complete story on Kinney Rotary Vacuum Pumps.

KINNEY Vacuum Pumps

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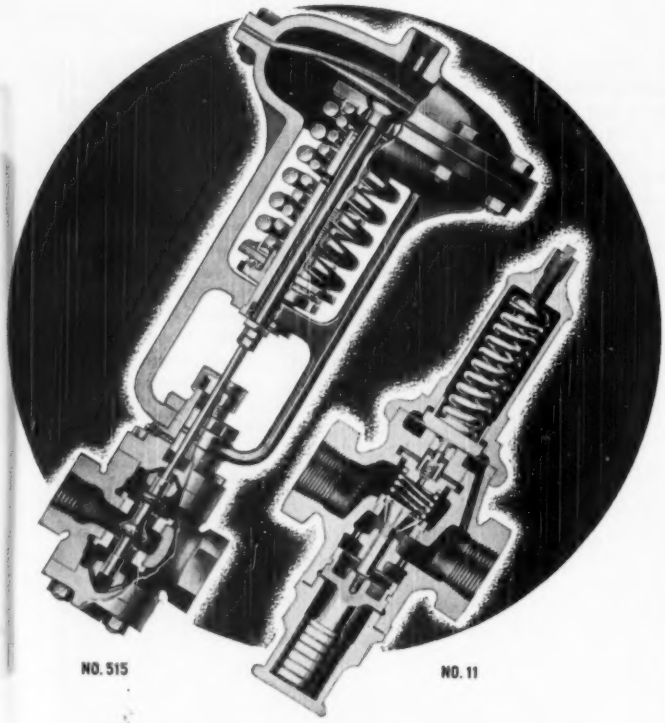

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Atlanta • Denver • Salt Lake City
Cincinnati • Boise • Albuquerque

Mason-Neilan Regulator Co., Ltd., Montreal and Toronto

parators. It includes reference sections on the control of pH, chlorine and phosphate as they affect water treatment and processing operations.

X13 **BOILER - WATER TREATMENT**—E F Drew & Co, Power Chemicals Div, 15 E 26th St, New York 10, N. Y. Booklet covers the Drew system of complete boiler-water treatment, and includes photographs of each step in the process. Various aspects of both chemical and organic treatment are discussed.

X14 **WATER SOFTENER** — Graver Water Conditioning Co, Dept 103, 216 W 14th St, New York 11, N. Y. 12-page article No. TA-115 presents operating data from several commercial hydrogen-zeolite installations. Contains tables of results obtained and charts showing characteristics of several types of zeolites.

OTHER EQUIPMENT

Z41 **COMPRESSORS**—Joy Mfg Co, Henry W Oliver Bldg, Pittsburgh 22, Pa. 16-page bulletin No. A-56 contains informative data on the Joy WL-80 Unitair compressors. An easy-to-use selector chart, detailed section drawings and parts photographs illustrating economy and operating features are included.

Z42 **TIME-CYCLE CONTROLLERS** — Taylor Instrument Companies, Rochester 1, N. Y. 16-page catalog No. 98154 features Flex-O-Timer time-cycle controllers, which are particularly adaptable to those applications that have a mutiplicity of functions to perform during the course of a cycle.

Z43 **THERMAL INSULATION** — Infra Insulation Inc, 10 Murray St, New York, N. Y. 44-page book No. 37-B-4 sets forth simplified physics of thermal insulation. Subjects covered are: heat transfer, condensation, vapor, vermin, mold, fire, radiant heating.

Z44 **ARC WELDERS** — Hobart Brothers Co, Box DM-853, Troy, Ohio. 4-page folder No. J-2767 shows and describes 15 features of gasoline-engine-driven arc welders. Specifications of 10 different models of above and combination models of arc welders and power units are listed.

Z45 **NEW AND REBUILT EQUIPMENT**—Glow Electric Co, 933 Harriet St, Cincinnati 3, Ohio. 48-page Stock List No. 101 gives brief specifications for new and rebuilt ac and dc motors, generators, and generator sets, frequency changers, transformers, welders, speed reducers, centrifugal pumps, air compressors, blowers, motor starters and miscellaneous equipment currently in stock.

Air Conditioning Maintenance Class

Bahnson Co, Winston Salem, N.C., has just concluded its second annual series of maintenance engineer classes conducted for mill men who operate Bahnson equipment. A total of 99 maintenance men from 56 mills in 12 states and one foreign country attended the two one-week sessions. The purpose of the course is to keep men abreast of new developments in both equipment and technique as well as assure maximum care and efficiency of already installed equipment.

The course divides into three main topics: refrigeration, air distribution, controls. Instructors came from Minneapolis-Honeywell, Brown Instrument Co, Johnson Service Co, Marlo Coil Co, Spoolan Valve Co, Worthington Pump and Machinery Corp, Westinghouse Corp, Raytheon Corp, Ingersoll-Rand Co, Betz Engineering Corp, American Pulley Co, C H Wheeler Co, Mundet Cork Co, American Blower Co.

It's new . . . inside and out

WARREN *Cradle Mounted* COMPACUNIT

? Do you want to handle corrosive materials that might injure the motor on a close-coupled pump?

? Do you want to use a standard or special motor or turbine?

? Do you want to use a V-Belt drive that will permit a wide range of speeds?

. . . then a Warren Cradle Mounted Compacunit could be the answer. This versatile, efficient and sturdy pump is built to "stand the gaff"... and the price lower than you might expect for a quality product of this kind.

Sizes: 1", 1½", 2", 3"
Capacities: 5 to 450 G. P. M.
Heads: 15 to 500 feet
Materials: Standard, All Iron, All Bronze, or special to meet your requirements

Why not check this pump against your next pumping job, if within the indicated operating conditions? Ask for bulletin #242

P-21

WARREN STEAM PUMP COMPANY, INC. WARREN, MASSACHUSETTS

WARREN Compacunit PUMPS

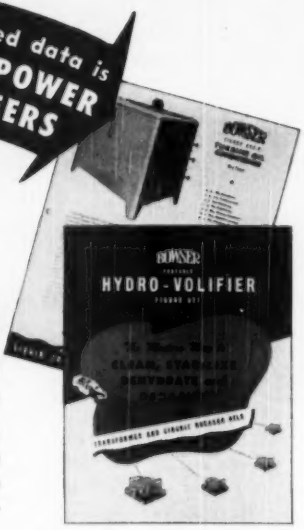
FACTS about OIL RECONDITIONING for POWER ENGINEERS

This fact-packed data is FREE to POWER ENGINEERS

BOWSER ESTABLISHED 1885

HYDRO-VOLIFIER

. . . for Transformer and Circuit Breaker Oils



In a single pass, oil dielectric is restored to 35 k.v.! Volatile corrosive acids, gases, dissolved moisture and solids—the enemies which promote sludge formation in insulating oils—are effectively removed.

THERE ARE NO SERVICE INTERRUPTIONS because this exclusive Bowser process reconditions transformer oils while energized!

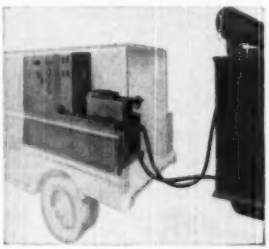
TURBINE OIL UNIT

"Bone dry," crystal clear oil from a Bowser reconditioner is the best stay-on-the-job insurance any turbine bearing can have. Inhibitors are not disturbed and there are no moving parts.

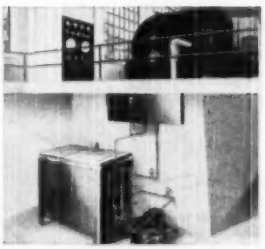
In some plants, turbines served by Bowser units have not had the oil changed for many years.

• • •

Bowser insulating oil and turbine oil reconditioners are effecting substantial reductions in operating costs in many plants. Less standby equipment is needed.



Portable Hydro-Volifier (also suitable for stationary service)



Turbine Oil Reconditioner

Write for descriptive information today.

BOWSER, INC.

1326 Creighton Ave., Fort Wayne 2, Ind.

LIQUID CONTROL SPECIALISTS SINCE 1885

POWER NEWS

(*Continued from page* 138)

Moreland of Boston, are consulting engineers for the project and responsible for the design.

Erection of all power plant equipment and construction of the warehouses, shops and other auxiliary buildings is being performed by the Puerto Rico Water Resources Authority.

Power Survey Indicates Reserve

Power Survey Committee of the Edison Electric Institute has recently completed its semiannual survey. This survey establishes these facts for the immediate present and the next few months.

The electrical industry had a reserve generating capacity of 11½%, on a nationwide average, during the December peak-load period. This contrasts with a 5.9% reserve last year.

Generating capacity increased 26% in three years' time by the end of 1949. This percentage represents over 13-million kw of new capacity—an addition exceeding the total generating capacity of the industry in 1920. New generating capacity installations are proceeding according to schedule.

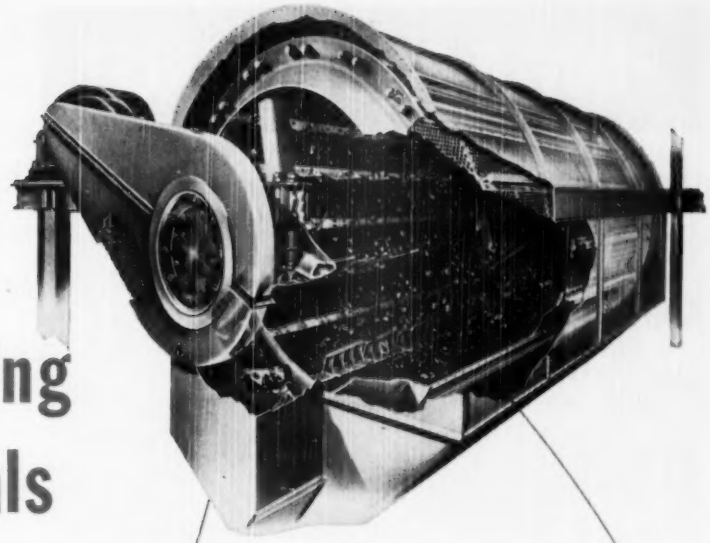
Manufacturers can now produce 8-million kw of steam-turbine capacity and 2-million kw of hydroelectric capacity. This is a total annual factory production of 10-million kw.

American Society of Mechanical Engineers' Boiler Code Committee has found it necessary for the past ten months to recommend a number of changes and additions to the various sections of the code. These include: (1) revision of the preamble of the low-pressure heating boiler code to define more clearly capacity limits of hot-water supply boilers (2) revision of the classification of welding operators (3) amplification of stress tables P-7 and U-2 to assign allowable working stresses to SA-213 materials in Grades T7 and T9 (4) revised formulas for bolted flanged connections (5) provisions for construction of unfired steam boilers in both the power boiler and unfired pressure vessel codes (6) adoption of working stresses for use with copper, nickel, and aluminum materials and their alloys (7) revisions of 36 existing material specifications and inclusion of six new specifications.

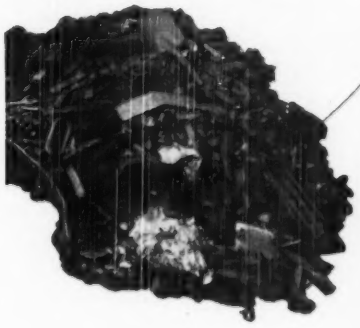
A new $10,500,000 power plant has been completed at Lower Salmon Falls on the Snake River near Hagerman, Idaho, by the Idaho Power Co. The 65,000-kw plant—Idaho Power's largest—is the fourth new plant completed by the company since the war and, along with three other plants, has doubled the company's prewar generating capacity, President T E Roach of Idaho Power said.

Roach has announced that the company is investing $78,000,000 in electric facilities and is continuing exploration and engineering studies for future power-plant construction as the need develops.

Uniform, Free-Flowing Steam Coals



minus debris

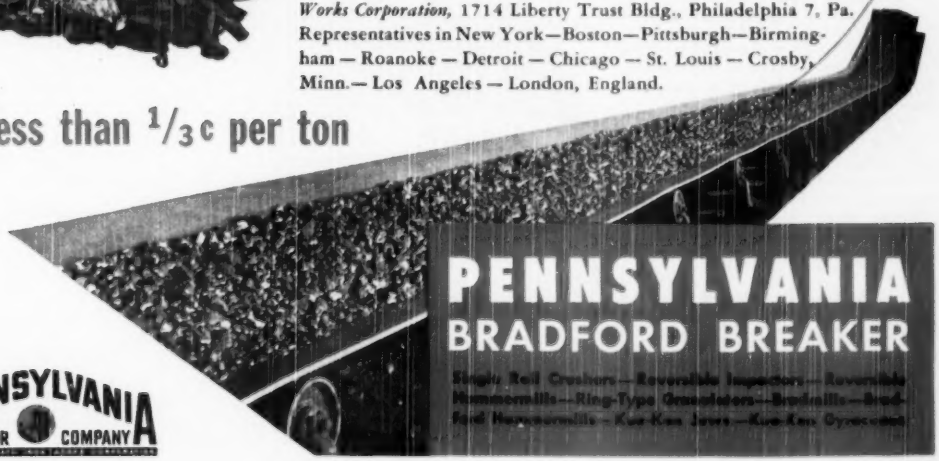


for less than 1/3¢ per ton

Pennsylvania Bradford Breakers crush and clean ROM coals in *one* operation. Mechanically simple, the Pennsylvania Bradford is a big, revolving, screening cylinder fitted internally with deflecting lifting shelves. Coal, delivered to the feed end, is continuously lifted and dropped as the cylinder turns at an economical 12-18 RPM. Passing sizes escape through the screen holes immediately (no overcrushing), while larger lumps stay trapped until shattered by the constant drop impact. All debris larger than the screen perforations travels to the end of the breaker and is automatically scooped out by a plow. The result: a uniform product containing minimum fines, no oversize, no large debris—an ideal feed for efficient pulverizer and stoker operation. Debris elimination minimizes damage and shutdown of pulverizers.

Power demand of these Steelbuilt Pennsylvania Bradfords—less than ¼ HP per ton. Maintenance costs—less than $.001 per ton for parts *and* labor. For Central Stations and Industrial Plants; capacities up to 1000 TPH. Write for Bulletin 3007.

PENNSYLVANIA CRUSHER COMPANY, *Division of Bath Iron Works Corporation,* 1714 Liberty Trust Bldg., Philadelphia 7, Pa. Representatives in New York—Boston—Pittsburgh—Birmingham — Roanoke — Detroit — Chicago — St. Louis — Crosby, Minn.— Los Angeles — London, England.

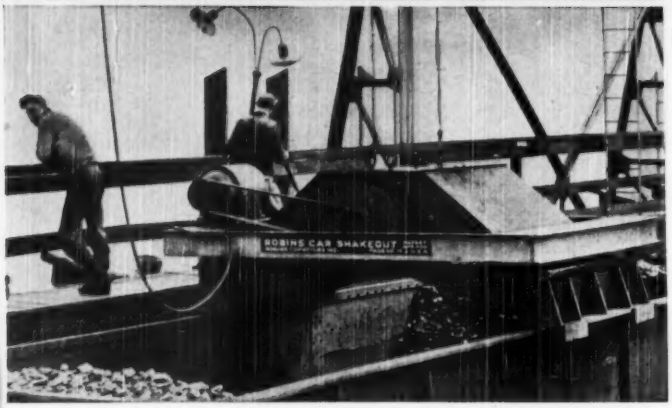


PENNSYLVANIA BRADFORD BREAKER

Single Roll Crushers—Reversible Impactors—Reversible Hammermills—Ring-Type Granulators—Bradmills—Bradford Hammermills—Kue-Ken Jaws—Kue-Ken Gyrocones

PENNSYLVANIA CRUSHER COMPANY

PROVEN PERFORMANCE!



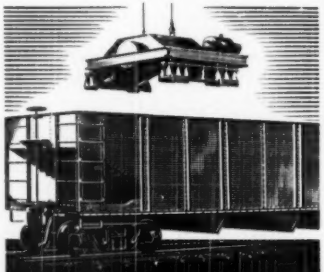
"PUSH-BUTTON" UNLOADING SAVES TIME, MONEY AND LABOR FOR OVER 500 USERS

Just push a button . . . and the intense vibration generated by the Hewitt-Robins Car Shakeout does the rest. It unloads 50 and 70 ton cars in as little as 90 seconds. It unloads them no matter how tightly the load is packed.

Continuous field operation by over 500 users proves that the Hewitt-Robins Car Shakeout is actually *twelve times faster* than manual unloading. And because it empties hopper cars "broom clean," no material is left in the car. One user reports that he saves a full car of coal out of every 200 unloaded!

The Hewitt-Robins Car Shakeout practically eliminates demurrage charges. It cuts the unloading crew from five or six to two—even one. It ends damage to cars, danger to workmen . . . makes a tedious, expensive operation quick, simple and safe.

Hewitt-Robins originated the Car Shakeout; Hewitt-Robins has by far the greatest backlog of experience in vibrating car unloaders. Two models are available—Model GS for general service, where car receipts are 15 cars a day or less, and Model HD for continuous, heavy duty, high speed unloading. A note on your company letterhead to Robins Conveyors Division, Passaic, N. J., will bring full particulars about this better, *proven* way to unload hopper cars.



HEWITT-ROBINS CAR SHAKEOUT

HEWITT-ROBINS (HR) INCORPORATED

BELT CONVEYORS (*belting and machinery*) • BELT AND BUCKET ELEVATORS
CAR SHAKEOUTS • DEWATERIZERS • FEEDERS • FOAM RUBBER PRODUCTS
FOUNDRY SHAKEOUTS • INDUSTRIAL HOSE • MINE CONVEYORS • MOLDED RUBBER GOODS
RUBBERLOKT ROTARY WIRE BRUSHES • SCREEN CLOTH • SKIP HOISTS • STACKERS
TRANSMISSION BELTING • VIBRATING CONVEYORS, FEEDERS AND SCREENS

NEW EQUIPMENT BRIEFS

(*Continued from page* 190)

the brake disks provide high wearing resistance, eliminating adjustments and replacements for all normal applications. Brake available separately for mounting on NEMA standard D flange motors in frames 203 to 326, or C face motors in frames 364 to 405 with standard double-shaft extension.

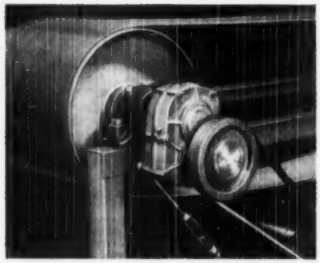
Crocker-Wheeler Electric Mfg Co, Ampere, N. J.

HIGH-SPEED ELECTRODE P376

New-principle high-speed electrode *Steel-Tectic* welds bead over bead without the need for removing slag.

Steel-Tectic 5/32 in. electrode can be used at as low as 50 amp on thin steel without burning through. *Frigidarc* flux coating makes this electrode performance possible. It forms a protective envelope around the weld area permitting a spray deposit free of weakening oxides and inclusions.

Eutectic Welding Alloys Corp., 40 Worth St, New York 13, N. Y.



SPEED REDUCER P326

Torque-Arm Speed Reducer consists of a reducer with fixed 15 to 1 ratio motor-driven through a V- or flat-belt. Any output speed from 13 to 133 rpm can be obtained through use of stock sheaves. Reducer contains a double train of helical steel gears.

A torque arm anchors the reducer and provides quick, easy adjustment of belt tension by a turnbuckle. No sliding motor base or flexible coupling is needed. Different output speeds can be attained by changing one of the sheaves in the drive. Unit comes in six sizes with capacities up to 28.5 hp. Bulletin No. A-470 gives complete information, also tables for easy selection of correct size.

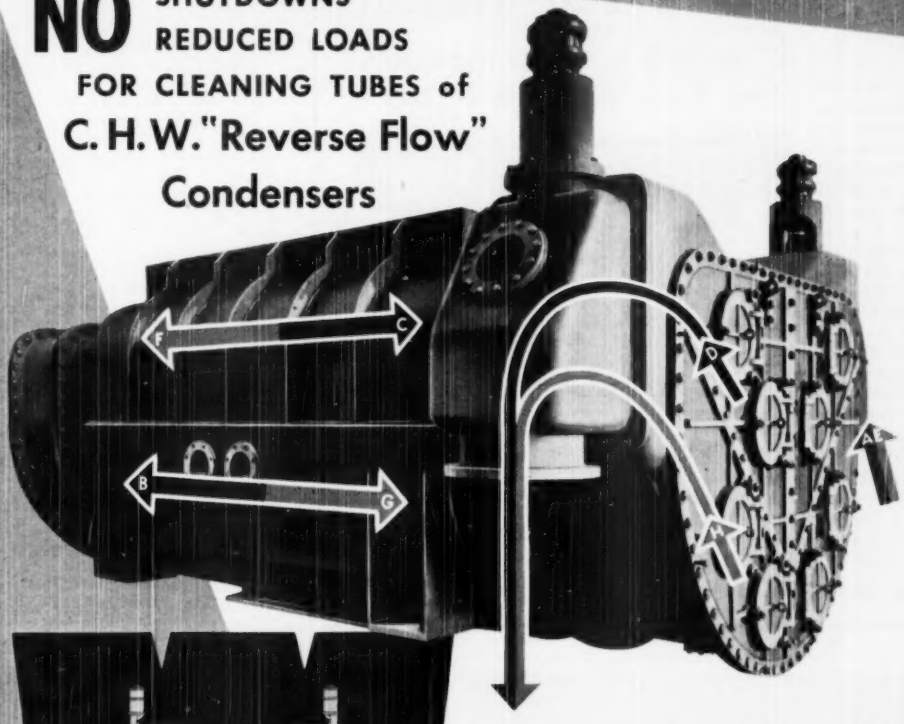
Dodge Mfg Co, Mishawaka, Ind.

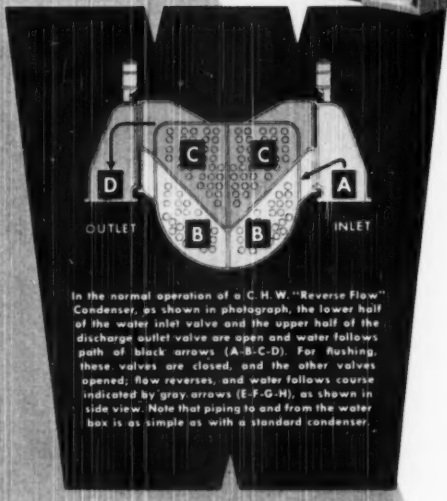
CHIPPING HAMMERS P307

Fifteen power sizes with five basic hammers make possible a wide range of chipping hammers to meet exact cutting conditions required by present-day metals. Controlled-power chipping hammers are available in normal-cut, extra-cut or super-cut design.

A new hard-surfacing Iramet process increases piston life by 12.3 times. An *Airite* valve accurately proportions the

NO SHUTDOWNS REDUCED LOADS FOR CLEANING TUBES of C. H. W. "Reverse Flow" Condensers





In the normal operation of a C. H. W. "Reverse Flow" Condenser, as shown in photograph, the lower half of the water inlet valve and the upper half of the discharge outlet valve are open and water follows path of black arrows (A-B-C-D). For flushing, these valves are closed, and the other valves opened; flow reverses, and water follows course indicated by gray arrows (E-F-G-H), as shown in side view. Note that piping to and from the water box is as simple as with a standard condenser.

Tubes of any condenser can become clogged with sand, leaves, twigs and other debris that gets by water screens. This means a cleaning job has to be done. For condensers with undivided water boxes, it means frequent shutdowns and, for divided water box condensers, it means operating at a reduced load. But that's not the case with C. H. W. "Reverse Flow" Condensers. All you do is push a button and reverse the water flow which flushes out debris quickly and economically. Consequently, you get the economies of continuous, peak-load efficiency and virtually eliminate costs of cleaning clogged tubes. "Reverse Flow" savings are available for any size condenser, the smallest now operating being 10,000 sq. ft. and the largest, 50,000 sq. ft. YES, there'll be NO shutdowns or operating at reduced loads if you use C. H. W. "Reverse Flow" Condensers. Write for more information.

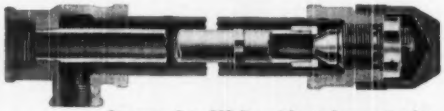
C. H. WHEELER MANUFACTURING CO.
1800 Sedgley Ave., Philadelphia 32, Pa.
REPRESENTATIVES IN MOST PRINCIPAL CITIES

C. H. Wheeler SINCE 1903

STEAM CONDENSERS · WATER COOLING TOWERS
EJECTORS · STEAM JET VACUUM REFRIGERATION
OF PHILADELPHIA

NOT 1 CENT For Repair Parts for 444 Nicholson Steam Traps Installed in 2 Years

Here is added evidence of the remarkably low maintenance costs of Nicholson expansion steam traps. In the 2 years Bradshaw & Co. have been distributing them in the Pittsburgh area they have installed 444 traps. But they have received not one order for repair parts. And examinations of traps in continuous drainage service for at least 18 months, at steam pressures to 250 lbs., showed no sign of valve cutting.



Pressure: 0 to 250 lbs. without change of valve or seat.

Length: 18" to 40" 2 types: thermostatic, continuous flow.

Easily Installed, Low Cost

Because valve is easily adjusted to pass condensate at any temperature below 212° F., these traps are also widely used for regulating temperature of equipment.

FOR ALL EQUIPMENT
Using Steam or Hot Water

Radiators	Dry Kilns
Separators	Vulcanizers
Paper Machinery	Switch Heaters
Pipe Coils	Laundries
Kettles	Plastic Molding
Railway Coaches	Presses

CATALOG 488
or see Sweet's

W. H. NICHOLSON & CO., 125 Oregon St., Wilkes-Barre, Pa.

The World's Fastest TUBE BENDING SERVICE

BOILER TUBE CO. OF AMERICA

McKEES ROCKS, PA. (Pittsburgh District)

amount of air fed to the front and rear of the piston to maintain top cutting efficiency and a smooth, full flow of power.
Ingersoll Rand Co, Phillipsburg, N. J.

FIRE EXTINGUISHER **P356**

Model B dry-chemical fire extinguisher, completely watertight, has specially designed seals inside nozzle and receiver.

Other features are threaded hose connections, new cartridge-guard finger grip and redesigned carrying handle. Available in 20- and 30-lb sizes. Manufacturer says freight allowances are being granted on shipments of 200 lb or more.
Ansul Chemical Co, Marinette, Wis.

CONTROL VALVE **P346**

Nonlubricated cylindrical-plug industrial control valve provides leakproof shutoff. Design includes a permanent seal at the plug stem, sealing packing at base of plug, a fixed-load spring and micro-finish on plug and body bore. Greatest torque is about 250 in.-lb at 250-psi line pressure.
Minneapolis-Honeywell Regulator Co, Belfield Valve Div, Philadelphia 44, Pa.

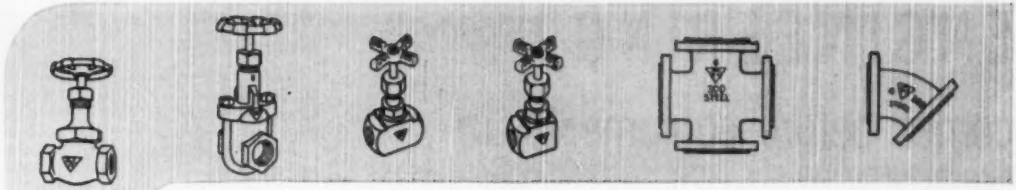
PROTECTIVE COATING **P313**

Heat-and-weather-resistant protective coating withstands temperatures up to 750 F in weather-exposed service. Silicon resins make up the silicone coating aluminum and give it high inertness, heat stability, high water repellency and low moisture absorption.
Dampney Co of America, Hyde Park, Boston 36, Mass.

SMOKE-DENSITY INDICATOR P399

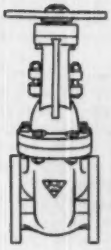
Continuous indication of boiler flue gas can be had with photoelectric smoke indicator *2A10C*.

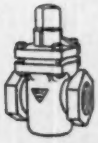
Indicator consists of a photoelectric control, a light source and a densometer. The control consists of a phototube and an electronic amplifier that operate a dual-relay system and indicating meter in the densometer. The photoelectric control and light source mount on opposite sides of the flue or breeching.
Photoswitch Inc, 77 Broadway, Cambridge 42, Mass.

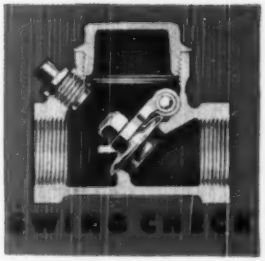


Quick-Acting · Positive · Dependable

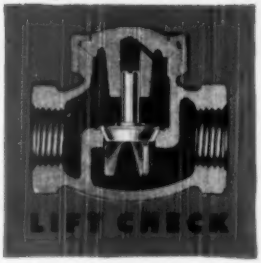
BRONZE CHECK VALVES by R·P&C







• For use where flow is not pulsating—where velocity is low or moderate. Has renewable disc, regrinding seat. Disc free to rotate, thus distributes wear uniformly over disc and seat.



• For services where flow is pulsating or velocity high. Generally used with Globe and Angle valves. Resistance to flow greater than Swing Check. Suitable in horizontal lines only.

***For information** about bronze, iron and steel globe, angle and check valves — bar stock valves — iron cocks — cast steel fittings — get in touch with your R-P&C distributor.*

ACCO

Reading, Pa. · Atlanta · Baltimore · Boston · Chicago · Denver · Detroit · Houston
New York · Philadelphia · Pittsburgh · San Francisco · Bridgeport, Conn.

R-P & C VALVE DIVISION
AMERICAN CHAIN & CABLE

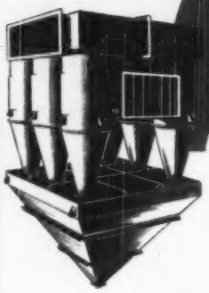
TRADE MARK

READING-PRATT & CADY VALVES

ENGINEERING

comes before equipment...in

FLY-ASH COLLECTION



Merely hopeful buying is unnecessary. In Buell experience, each job is sufficiently different from all others to warrant complete analysis and individual job engineering. Our specialized experience in this direction is yours for the asking . . . with no obligation whatsoever. If a cyclone collector is to be recommended, Buell has the patented van Tongeren 'Shave-Off' to do away with double eddy inefficiencies. If you are interested in principles, write for our catalog . . . if you have a specific problem, outline it for us. Remember . . . no obligation is involved. Write: Buell Engineering Company, 70 Pine Street, Suite 5045, New York 5, N. Y.

buell

Engineered Efficiency in

DUST COLLECTION

World's First Breeder Reactor

Contract to build the world's first known atomic "breeder" reactor has been announced by the Atomic Energy Commission. A breeder reactor is one that produces more than a pound of new nuclear fuel for each pound consumed. Natural uranium consists of one part of uranium 235, and 139 parts of uranium 238. Only the U235 part is fissionable. Flying neutrons in a reactor, however, convert some of the U238 into plutonium, which is as good a fuel as U235. It has long been considered theoretically possible to convert all the U238 into plutonium in this manner. Thus the whole mass of natural uranium is ultimately made available as a fuel, instead of a mere one part in 140.

Construction of the reactor at the AEC's new testing station at Arco, Idaho, will take about a year. Some time in 1951 actual tests may show whether breeding of fissionable material is practically possible.

Bechtel Corp of San Francisco will build the housing of the Arco pile under a 2.5-million-dollar contract. The uranium pile itself will be furnished by Argonne National Laboratory where it is being designed and built at a cost of around one million dollars.

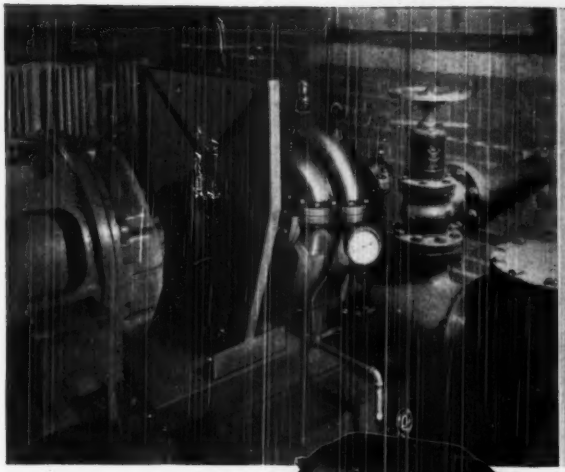
Since successful breeding multiplies the available atomic-fuel supply 140 times, it is naturally a major goal for both bomb production and successful atomic-power production. Plutonium produced in a breeder pile is an ideal explosive for atom bombs as well as fuel for atom power plants.

The AEC has also announced a new time table for three other atom furnaces. The electric power-producing reactor planned for the Knolls Atomic Power Laboratory near Schenectady, N. Y. is in the engineering design stage, but construction of major facilities at the site will start next spring. This plant will also be a breeder. Molten metal will be used to convey heat from the reactor to the steam generators. This plant will cost from 25 to 40 million dollars.

A materials-testing reactor will be built at the Idaho site. Construction will start next spring. Aim is to find out what materials can withstand the radiations in atomic furnaces and be otherwise suitable for reactor construction. This reactor will cost about 25 million dollars.

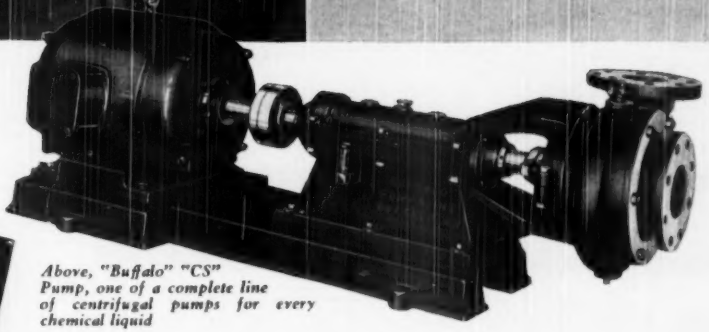
A ship-propulsion reactor will be under construction near Pittsburgh by 1952. It will cost another 25 million dollars.

Jas P Marsh Corp announces a change in its sales and manufacturing structure. Sales of the newly acquired Electrimatic line of refrigeration control valves and regulators are to be handled by Electrimatic Co. Sales of all Marsh pressure gages, dial thermometers and related products will be handled by Marsh Instrument Co. As for some years past, sales of Marsh traps, valves and other heating specialties will be handled by Marsh Heating Equipment Co. Each of these organizations will be designated as sales affiliates of Jas P Marsh Corp.

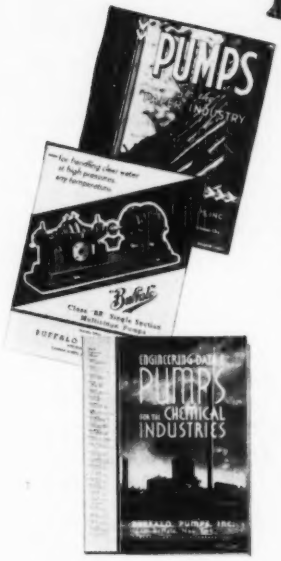


LONG ON THE JOB SHORT ON REPAIRS

"BUFFALO" PUMPS



Above, "Buffalo" "CS" Pump, one of a complete line of centrifugal pumps for every chemical liquid



● Users in every branch of industry report two things about "Buffalo" Pumps: (1) they stay on the job for years with minimum maintenance, and (2) they do their given jobs efficiently.

It's costly to buy a "temporary" or inefficient pump just to save a few dollars on first cost. Write for Bulletins 953-G, 980-B and 982—see how "Buffalo" Pumps pay off in long-term efficiency!

"Buffalo" PUMPS

BUFFALO PUMPS, INC.

488 BROADWAY BUFFALO, N. Y.

Canada Pumps Ltd., Kitchener, Ont.

Branch Offices in All Principal Cities

Specify VIKING For Your Future PUMP PLANS

Check today on your pumping equipment needs. Viking offers the most complete line in the rotary pump field. The range of sizes and styles are the largest available.

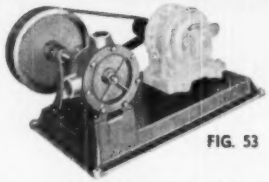


FIG. 53

Quiet V-Belt Motor Driven Unit

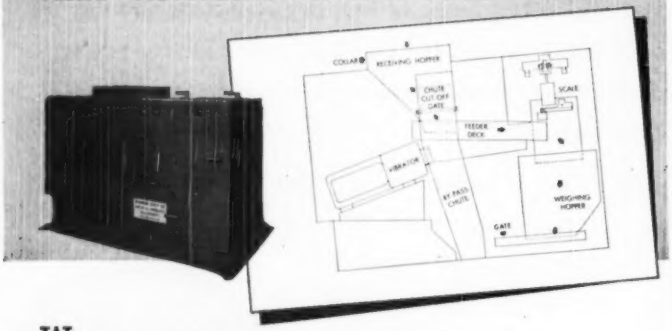
Each is built to handle the specific job. Outstanding features include fast self priming . . . smooth, even discharge . . . low power requirements . . . compact and rugged construction.

Send today for free bulletin 50SW.

See Our Catalog In SWEETS

Viking PUMP COMPANY
Cedar Falls, Iowa

No Troublesome Belts . . . IN THE BEAUMONT "VIBRO" AUTOMATIC WEIGHING SCALE



WHY bother with belts, pulleys and motors in weighing scales?

The stainless steel vibrating feeder in the Beaumont "Vibro" Automatic Weighing Scale has no belts or moving parts—eliminates faults. It is particularly well adapted to very abrasive materials and the rate of feed can be easily adjusted by a rheostat controlling the vibration of the feeder.

Other features include: high weighing accuracy, feeder capacity from 1 to 60 tons per hour, dust proof construction, quiet operation and long life. We can promise prompt shipment on standard units. Write for descriptive bulletin.

BEAUMONT BIRCH Company
1502 RACE STREET—PHILADELPHIA 2, PA.

Designers Manufacturers Erectors BULK MATERIAL HANDLING SYSTEM

Industrial Air Needs Purity Standards

Frank A Patty, head of research industrial hygiene dept, General Motors Corp, outlined some air-pollution problems still to be solved in an article, "Air Contamination Standards," for the quarterly journal *Standards World*.

The major problems, as Patty sees them, are: (1) insufficient data on physiological effects of continued exposure of human beings to contaminants (2) lack of standards for permissible concentrations of air-contamination concentrations actually safe for humans (3) fear of unnecessarily severe and impractical limits being set (4) conflicting viewpoints of experts. These problems, Patty points out, still exist despite a 10-year study.

General Electric Co Describes Aerosol Counter

Under Project Cirrus, a joint weather research program of the U S Army Signal Corps and the Office of Naval Research in consultation with GE research laboratory, a special device has been developed to count aerosols measuring less than a millionth of an inch in diameter.

Dr Bernard Vonnegut, weather scientist for GE, feels the device should prove valuable in air-pollution studies to trace development and dissipation of various smokes from industrial centers.

As described by Dr Vonnegut the instrument consists principally of a cloud chamber, through which a beam of light is directed, an air pump which compresses and expands air three times a second in the cloud chamber, a moisture supply that introduces moisture into the chamber, and a light-sensitive photoelectric cell or eye to watch the beam of light.

Air to be tested passes through the chamber. Three times a second, the sudden expansion of this air condenses out moisture on any particles present to form a fog. The light scattered from the beam varies with the number of fog drops formed and the electric eye detects these changes. There is then a calibration arrangement for determining particle count.

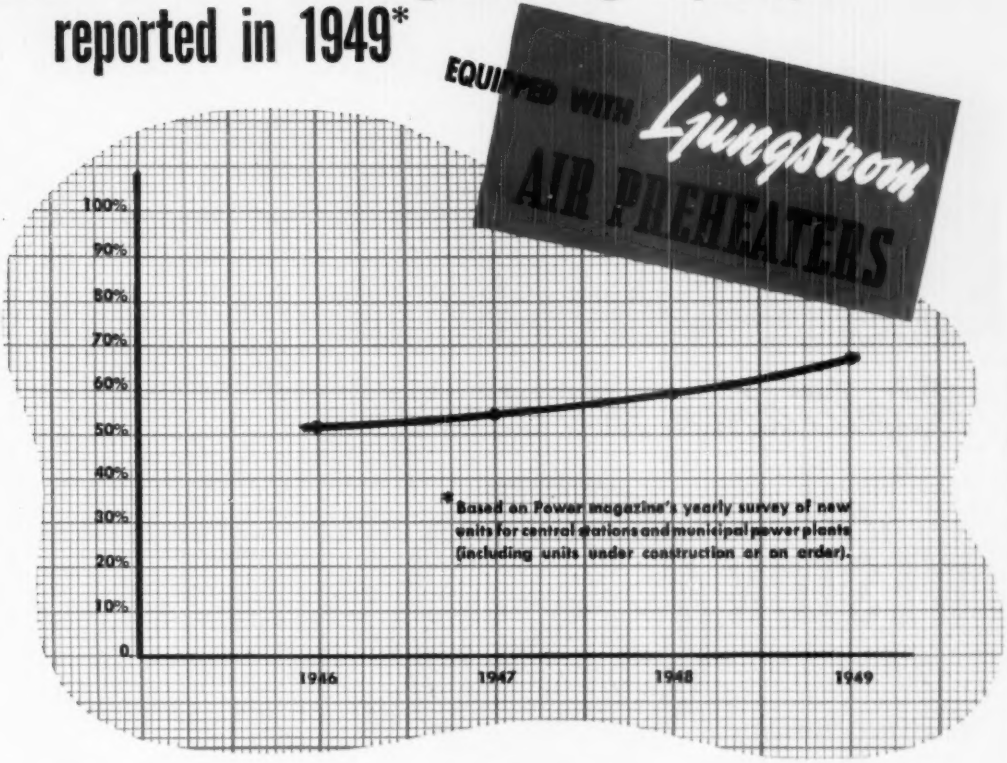
Pennsylvania Sets Up State Air Pollution Studies

Dr Norris W Vaux, secretary of the Dept of Health, Commonwealth of Pennsylvania, announced plans for a statewide program to determine effects of polluted air on public health. The program will be under the direction of Dr Joseph Shilen, director of the State Bureau of Industrial Hygiene.

A unique, mobile field laboratory now being built at the Mine Safety Appliances Co, Pittsburgh, will serve as the principal means of attack. Headquarters will be in Harrisburg under J S Sharrah.

This new laboratory will be able to take air samples and run on-the-spot analyses. Among its equipment will be an electrostatic dust and fume sampler, sulphur dioxide, carbon monoxide, nitrogen dioxide and benzol detectors and an osmoscope, for identifying odors.

Over 65% of steam generating capacity reported in 1949*



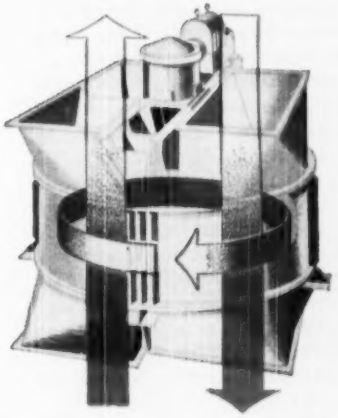
Again in 1949 utilities continued to register an increasing preference for the Ljungstrom regenerative air preheaters. Over 65% of the steam generating capacity for central stations and municipal power plants (including units under construction or on order) reported in Power magazine's 1949 Modern Plant Survey will be equipped with Ljungstrom air preheaters.

The reasons behind this wide acceptance of the Ljungstrom, the only regenerative type air preheater, are sound and simple:

1. High Heat Recovery: The Ljungstrom air preheater, by employing the continuous regenerative counterflow principle, assures the highest practical heat recovery, up to 70% of the total heat in the stack gases.

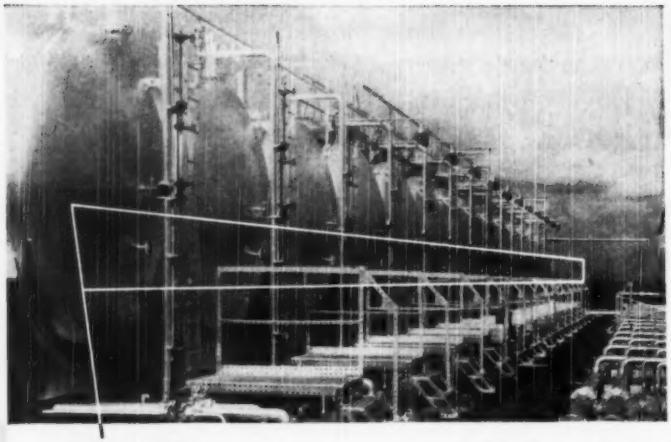
2. Low Operating Costs: The regenerative principle provides accurate control of metal temperature throughout the entire unit. This permits operation with low maintenance costs, under conditions which would cause rapid deterioration in other designs.

3. Reliability: The high availability of the Ljungstrom air preheaters with all types of boilers, under every condition of operation, is a matter of record in power plants throughout the country.



The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.

THE AIR PREHEATER
60 EAST 42d STREET • NEW YORK 17, NEW YORK
CORPORATION

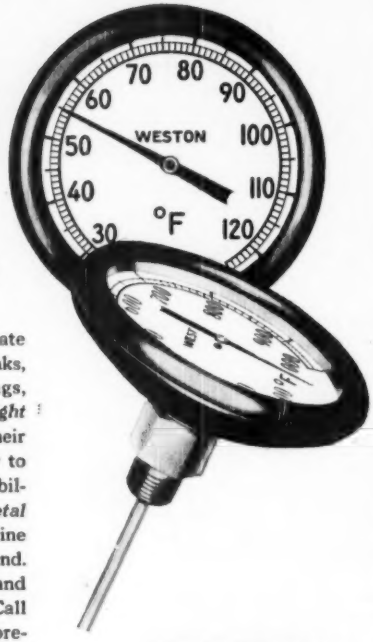


Right down the line!

it's

WESTON

All-Metal Thermometers



Wherever you need quick, accurate temperature readings—on tanks, processing equipment, bearings, pipe lines—specify WESTONS *right down the line.* Not only are their large, boldly marked dials easy to read, but their accurate dependability is assured by WESTON'S *all-metal* construction. They stay on the line longer—cost far less in the end. Available in types, stem lengths and ranges for most applications. Call your jobber or local WESTON representative, or write for Thermometer Bulletin. WESTON Electrical Instrument Corporation, 679 Frelinghuysen Avenue, Newark 5, N. J.

CONTACT-MAKING models for alarm or control purposes. MAX-MIN models to indicate highest or lowest temperature reached.

WESTON *Instruments*

APPOINTMENTS

Youngstown Sheet & Tube Co, Youngstown, Ohio, names Roy A Curl manager of its sales promotion dept succeeding Myron S Curtis, who is now assistant to the president. John M Tuthill becomes manager of flat rolled sales, replacing Walter E Scott who retired. L E Arnold succeeds Tuthill as assistant manager of flat rolled sales. In addition, Clyde M Horan is transferred to Youngstown district as superintendent of the firm's blast furnaces at Campbell and Hubbard, and sintering plant at Campbell.

Stephen A Sloan assumes duties as manager of research and development for **Peabody Engineering Co,** New York, N. Y.

The following are appointed sales representatives for **Pennsylvania Crusher Co:** Leatherman & Mertz, Detroit, Mich., handles Detroit and northern and eastern counties of Michigan's lower peninsula; Swaney Co, Newtonville, Mass., covers Massachusetts, Connecticut, Rhode Island, Vermont, New Hampshire, and Maine; Stanley B Troyer, Crosby, Minn., is assigned the Minnesota, northern half of Wisconsin, and Michigan's upper peninsula territory; Wharton L Peters Machy Co, St. Louis, handles all of Missouri, plus southern counties of Illinois and Indiana.

R E Barnett has been promoted to assistant sales manager of **Marsh Instrument Co,** Skokie, Ill., sales affiliate of Jas P Marsh Corp.

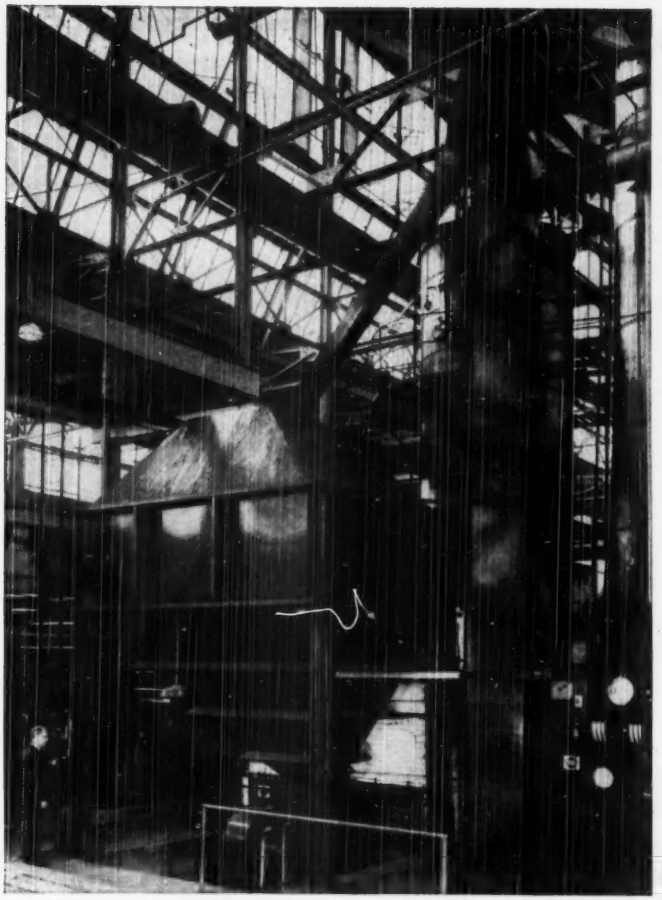
James H Binger is elected vice-president and general manager of **Belfield Valve Div** (Philadelphia) of Minneapolis-Honeywell Regulator Co.

Frank W Cramer has joined **Elliott Co** as consulting engineer. He will have headquarters at 718 Frick Building, Pittsburgh, Pa.

Changes in **Allis-Chalmers** general-machinery district-office personnel are announced as follows: A B Frost succeeds W F Taylor as manager of Boston office. Taylor will devote all his time to duties as regional manager. J E Smet is now manager of New Haven office. G G Fintak transfers to Boston office to assist sales representatives of New England region with hydraulic turbine and pump applications. G H Hoffman replaces J J Greagan, who is retiring, as manager of Birmingham district office. Greagan remains in Birmingham office as special representative. H C Sells is new manager of Knoxville office, now a branch of Chattanooga. Also, I K Cox is named to handle products of the crushing and cement div, basic industries machinery dept, for Empire region. He continues to make his headquarters in the New York office.

Herman Press, treasurer of **American Locomotive Co,** Schenectady 5, N. Y., has been appointed a director of the company.

Bridgeport Brass Co opens a new district sales office in Reserve Life Bldg, Dallas,



A single large Vulcan Ramfeed Stoker fires this 450 H. P. Wickes Vertical Waste Heat Type Boiler — automatically maintaining heat over week-end shutdowns with no attention.

"We switched from oil and gas to Canton Stoker fired coal and saved 2/3 of our former fuel cost"

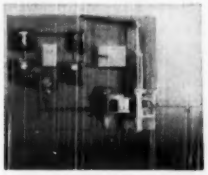
...says the well satisfied plant manager of Babcock Printing Press Corporation, Canton, Ohio

Building the gigantic, modern Babcock Rotary Printing Presses that print a whole magazine in four colors requires a huge high ceilinged plant, plus uniform temperatures for proper fitting of precision parts.

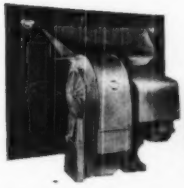
Both oil and gas were tried, but the cost proved excessive ... temperatures varied too much for precision work. CANTON'S Engineers were then called in on the problem, and a complete stoker and coal handling system were installed on their recommendations. In the *first* heating season, the installation saved considerably more than its cost, *returning a substantial profit on the investment* and paying added dividends in improved working conditions.

Consult a Canton Field Sales Engineer (in principal cities) and find out how CANTON STOKERS can help you with your heating or power problem. No cost or obligation is involved. Or write or wire direct to CANTON STOKER CORP., 741 Andrew Place S. W., Canton, Ohio.

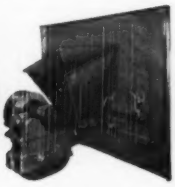
"Turbo-Aire" Jets—for smoke abatement, firing efficiency.



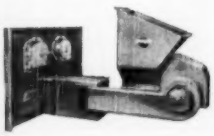
Synchronized Combustion Control Systems — for all boilers.



Vulcan Ramfeed Stokers —for loads up to 800 H.P.



LoSet Ramfeed Stokers— for loads up to 350 H.P.



Duraflex Wormfeed Stokers—for loads up to 175 H.P.

CANTON STOKERS

CANTON STOKER CORPORATION

741 ANDREW PLACE S. W., CANTON, OHIO

Gentlemen:

---Please send all descriptive literature at once

---Have a CANTON Engineer interview us immediately

Name _____

Company _____

Address _____

City _____ State _____

HENSZEY CONTINUOUS BLOWDOWN

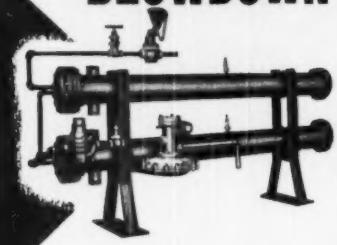
Prevents PRIMING

Prevents FOAMING

Prevents SLUDGE

Prevents SCALE

(with simple chemical treatment)



AN INVESTMENT THAT PAYS 50% INTEREST

The Henszey System automatically keeps boiler water concentrations within safe margins. This is accomplished continuously WITHOUT HEAT LOSS. Maintain clean, efficient boilers for substantial savings in fuel, equipment and manpower.

HENSZEY

Consult your nearest HENSZEY Representative or write to

HENSZEY COMPANY

Dept. D3 • Watertown, Wis.

CONTINUOUS BLOWDOWN and BOILER PLANT SPECIALTIES

Boiler Feed Regulators • Distillation Systems • Heat Exchangers
Feed Water Meters • Flow Indicators • Proportioning Valves
also MILK EVAPORATORS and PREHEATERS

YOU CAN CUT PIPING COSTS with CATAWISSA PERFECT SEAL UNIONS

CATAWISSA **HOT FORGED STEEL UNIONS** priced to compete with better grade malleable iron unions

a type for every use! CATAWISSA **STAINLESS STEEL UNIONS** machined from solid bars

WRITE FOR BULLETIN 10-A

CATAWISSA VALVE & FITTINGS CO.
206 Mill St. • CATAWISSA, PA.

Texas, under direction of B M Neilson, district manager.

Stoddard M Stevens, a partner in law firm of Sullivan & Cromwell, New York, has been elected a director of **Babcock & Wilcox Co,** New York City.

L B Wilson is promoted to general sales engineer in New York City office of **Dowell Inc.** Also, the New York office, formerly part of Philadelphia district, is now under the auspices of general sales dept in Tulsa, Okla.

General Electric Co's Apparatus Dept names the following men staff assistants in its large apparatus divs: P L Alger; Marshall Anderson; T M Linville; C H Ridgley; F P Wilson Jr. Construction Materials dept assigns James D Lowe to its New York district as wire and cable specialist. Lowe will make his home office at the Bridegport, Conn. plant. Apparatus agency division of GE's industrial divs is replaced by a newly organized agency and distributor div. George L Irvine and R D Moore are manager and assistant manager, respectively, of the new division.

James P Stewart has been elected executive vice-president of **De Laval Steam Turbine Co,** Trenton, N. J. He will continue as manager of commercial sales div. W A Reynolds has been appointed assistant to the president. W A Neumann Jr has become acting manager of IMO-De Laval products div, but will retain his title of controller.

Combustion Engrg—Superheater Inc, New York City, appoints Carl E Miller to the engineering staff of its industrial dept.

Carl F Norberg is elected executive vice-president of **Electric Storage Battery Co,** Philadelphia. Leland E Wells becomes Exide's chief engineer.

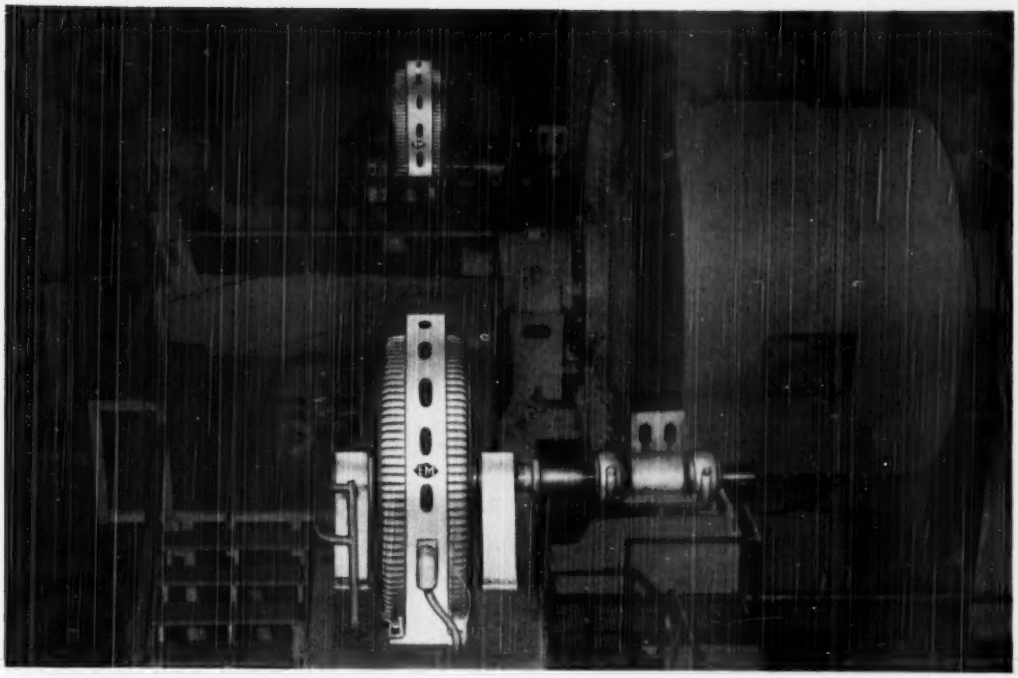
Graver Water Conditioning Co has chosen Fred S Renauld & Co, 1014 W 84th Pl, Los Angeles, Calif., as its representative in southern California, Mexico and lower California.

H S Colby joins **Springfield Boiler Co,** Springfield, Ill., as assistant to the president. In addition, Power Equipment Co, 4706 Holly St, Kansas City, Mo., will act as sales representatives for the firm in Missouri valley and western plains area of Texas, including Rocky Mountain area and the states of Wyoming, Montana and North Dakota.

Eagle-Picher Co, Cincinnati, Ohio, announces resignation of Douglas Via as sales manager of the company's industrial insulation dept. Walter D Myers Jr succeeds Via.

James A Ford, sales manager of **Jerguson Gage & Valve Co,** Somerville, Mass., has been elected vice-president and director of the firm.

Management changes in machinery div of **Dravo Corp,** Pittsburgh, are as follows: J K Beidler is assistant general manager;



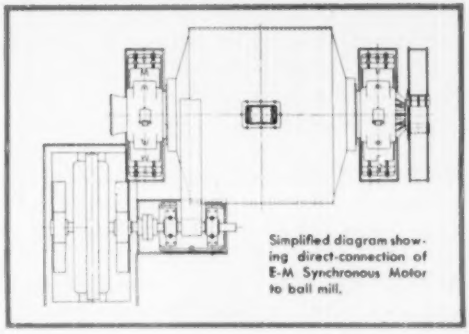
Biting off a bigger mouthful with direct-connected E-M Synchronous Motors

"Move more ore . . . save more space . . . cut power costs to rock bottom!" That was the recipe for profitable handling of low-grade ore, in new block-caving operations at the Bunker Hill and Sullivan mine, at Kellogg, Idaho.

The picture above shows how neatly the job is being done—with the simple, compact installation of E-M Synchronous Motors.

In this application two 400 horsepower, 240 rpm, high-torque E-M Synchronous Motors supply the drive by direct connection to 10'6" x 8'0" cylindrical ball mills, largest of their type to be installed recently. This compact drive provides highest efficiency in power conversion, high power factor, and high stability.

Wherever power costs are vital, wherever space is at a premium, direct-connected E-M Synchronous Motors offer important and inherent advantages, such as paying their own way in power factor improvement. These economical and dependable constant-speed drives are ideal for ball and tube mills, jordans, lineshafts, pumps, compressors.



Simplified diagram showing direct-connection of E-M Synchronous Motor to ball mill.

Write today for full information about E-M Synchronous Motors—the most efficient constant-speed drive in industry. Ask for Bulletins 175 and 181.

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

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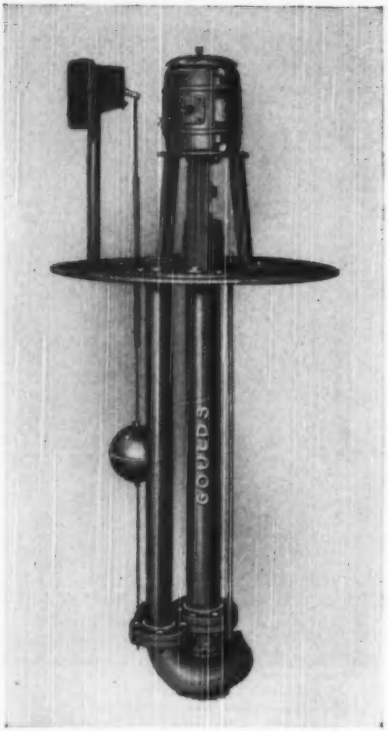
E-M

SPECIALISTS IN
BIG MOTOR ENGINEERING



Goulds vertical centrifugal Fig. 3047

For Dependable Heavy Duty Sump and Drainage Service

This rugged, heavy duty sump pump gives exceptional service in removing water from boiler room pits, pipe tunnels, elevator pits, cellars, basements. It is also widely used for transfer service where automatic control of liquid levels in vats or tanks is required.

CAPACITIES Fig. 3047 is available in four sizes for pit depths from 3 to 20 feet. Capacities from 10 to 650 G.P.M. with heads up to 130 feet depending upon capacity.

ADVANTAGES The unit comes complete with float, automatic switch and cover plate. The discharge pipe, pump support column and the cover plate are welded into a rigid unit assuring permanent alignment of upper and lower bearings. Lower bearing is protected by special pressure equalizing system to give long wear.

MEMBER

For complete information call or write Pump Headquarters or your nearest Goulds dealer. Ask for Bulletin 726.1.

Goulds PUMPS INC.
Seneca Falls
New York

R M Rush, manager of sales development; H M Graham, manager of apparatus dept; D R Berg, manager of heating dept; and B B Reilly, manager of air-conditioning and combustion dept. G P Smith succeeds Beidler as purchasing agent. In addition, Condaire Inc, 3248 Gravois, St. Louis, is chosen as distributor of Dravo "Counterflo" heaters in eastern Missouri and southern half of Illinois.

Robert L McFadin is transferred to main offices of **Marley Co** in Kansas City, Kansas, as manager of merchandising sales dept.

Graver Tank & Mfg Co, East Chicago, Ind., announces appointment of Harry A Dennis as manager of sales for the firm's stainless and alloy steels div. He will also continue his present assignment as manager of weldment sales. Robert F Millett becomes advertising manager.

Gulf Oil Corp, Pittsburgh, assigns Charles F Kottcamp and Roy L Wheeler to industrial products engineering. Both are chief fuels and lubricants engineers—Kottcamp with turbine and steam-power section and Wheeler with general-machinery section.

Phil Arnold, vice-president of **Garlock Packing Co,** Palmyra, N. Y., has relinquished his duties and responsibilities in charge of the company's general sales dept. Although retired, he continues in a partially active capacity, for an indefinite period, as vice-president. Louis Mohn has been made sales manager. Eugene G Flannery replaces Mohn as district manager at Pittsburgh.

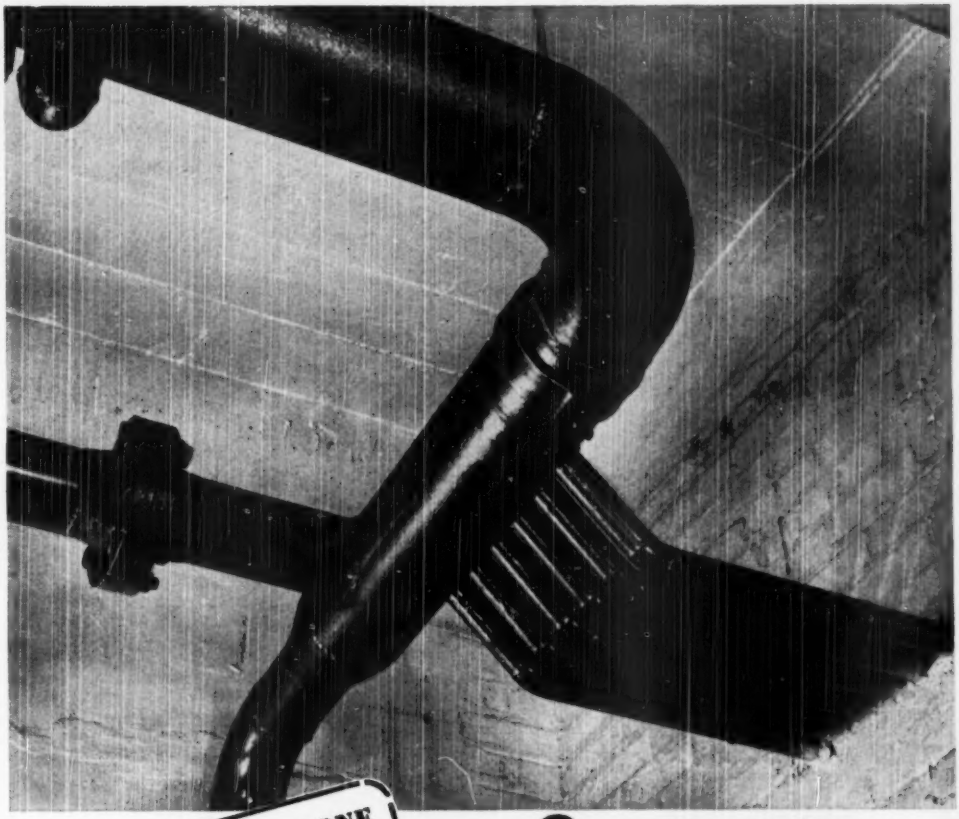
Worthington Pump & Machy Corp, Harrison, N. J. names Harry E Lewis assistant comptroller. Lewis succeeds the late Joseph A Schallenberg. New Eastern manager, engine div, is A M Boehm, with headquarters remaining in the New York office. Boehm succeeds W L Russel, who is assigned to handle Canadian sales for John Inglis Co, Worthington's Canadian associate. Also, Karl MacDonald, consulting engineer, retired from the company's steam turbine div, Wellsville, N. Y.

Milton F Beecher has been elected vice-president in charge of research and development for **Norton Co,** Worcester, Mass. George N Jeppson and Milton P Higgins have been re-elected board chairman and company president, respectively.

Whiton Machine Co, New London, Conn., selects O D H Bentley as consulting engineer in charge of new designs and developments of Whiton steam turbines for U. S. Navy, and also for commercial work. Eugene B Williams will take charge of the sale of steam turbines for U. S. Navy application.

Elmer A Kleinschmidt, Philip H Glattelter, William S Shipley and Stewart E Lauer have been re-elected to the board of directors, **York Corp,** York, Pa., for a 3-year term. Charles A Barnes has been newly

How to Tame a Tough Joint



ANOTHER JOB DONE BETTER WITH GLOBE WELDING FITTINGS

KEEP an eye on the future when you install piping — even the most innocent looking connection can become a "tough joint" through leakage — pressure-loss — the focal point for erosion and corrosion — constant maintenance time and cost.

You can tame probable "tough joints" in piping by making connections with permanently tight, leakproof Globe Welding Fittings. Strength is forged in the fittings — flow friction and pressure-loss minimized by precision formed true angles, radii, circularity—weight and space requirements reduced — exact dimensional accuracy that saves time, speeds piping assembly. To do any piping job better — use Globe Welding Fittings produced from Globe seamless steel tubes by the Globe Precision Process.

GLOBE STEEL TUBES CO., Milwaukee 4, Wis.

Producers of Globe seamless stainless steel tubes — Gloweld Welded stainless steel tubes — carbon — alloy — seamless steel tubes — Globeiron seamless high purity ingot iron tubes — Globe welding fittings.

For complete information on sizes and types send for Globe Welding Fittings Catalog.

GLOBE PRECISION PROCESS WELDING FITTINGS

LEAK DETECTORS

find leaks quickly

With G-E leak detectors you can easily locate even the smallest leaks in closed systems. Detectors are ideal for locating leaks in installed equipment or in the products you make.

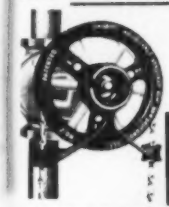
Use the Type H detector for pressure systems, the Type M for evacuated systems.* Write for Bulletin GEC-233 (Type H) or for GEC-336 (Type M). *Address Apparatus Dept., T687-21, General Electric Co., Schenectady 5, New York.*

**If the system is filled with combustible gas, write for special application information.*

GENERAL ELECTRIC

GET-21

NOW! All Overhead Valves are Instantly Accessible



with the LOW-COST

Babbitt *Adjustable* SPROCKET RIM *with Chain Guide*

● Range of 10 adjustable sizes takes care of all valve makes and types; fits valve wheel diameters from 2 to 30 inches.

● Overhead valves — no matter how high up, or in whatever hard-to-get-at location — are instantly accessible from the floor! Operation of valves is quick, easy, positive and safe with the BABBITT Adjustable Sprocket Rim with Chain Guide. No more climbing on bench, machine, boiler or treacherous stepladder; no time-wasting.

● The BABBITT Adjustable Rim fits all valves, with either rising or non-rising stems. It is installed quickly by clamping onto the hand wheel of the valve.

● Write today for Catalog Bulletin P, surprisingly low prices, and name of nearest distributor.

BABBITT STEAM SPECIALTY CO.
1 Babbitt Square, New Bedford, Mass.

appointed to position of assistant treasurer. All officers of the corporation were re-elected.

Phillip D Cannon succeeds Alexander Cromwell, who resigned recently, as vice-president of **Johns-Manville Products Corp,** New York City, and production manager of industrial products div. Cannon's responsibilities will include production supervision over Johns-Manville industrial products at Billerica, Mass.; Nashua and Tilton, N. H.; Manville and New Brunswick, N. J.; Marrero, La.; Redwood City and Watson, Calif.; Richmond, Ind.; Waukegan, Ill.; and Zelienople, Pa.

Standard Transformer Co appoints A J Elggren & Sons Co, 428 S W Temple St, Salt Lake City, Utah, as representative covering the states of Utah, Idaho and western Wyoming.

Arthur Schwarz is now vice-president in charge of sales for **Nooter Corp,** St. Louis Mo.

Pennsylvania Transformer Co, Pittsburgh, names Arnold L Horelick engineering manager and John J Zimsky chief mechanical engineer.

Hanrik Greger has been made diesel engine representative for **Lima-Hamilton Corp** in California, with headquarters at 315 25th Ave, San Mateo, Calif.

McDonnell & Miller Inc, Chicago, announces election of George H LaRoi as vice-president and James A Solon as treasurer.

Wayne D Staley is appointed general sales manager of **Duriron Co,** Dayton, Ohio. In directing sales and advertising activities, he replaces D E Jack, who resigned as vice-president in charge of engineering and sales. R F Sharpe becomes New York district manager. Philadelphia office will be under direction of Ralph L Watts.

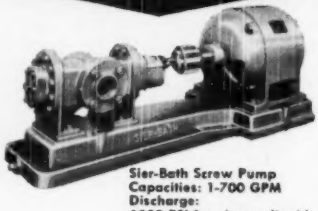
Chain Belt Co selects Arkansas Bearing Co, Markham & Rector Sts, Little Rock, Ark., and Winn Supply Co, 256 Seventh Ave, San Diego, Calif., as distributors for merchandise products of its Chain and Transmission — Baldwin-Duckworth — and Conveyor and Process Equipment divisions. Pacific Hardware & Steel Co, 1344 The Alameda, San Jose, Calif., and Polson Implement Co, Columbia & Western Ave, Seattle, Wash., will distribute merchandise products of Chain and Transmission and Baldwin-Duckworth divisions.

Crotty Mfg Corp, Flushing, N. Y., has named Edward T Alstrom general sales manager.

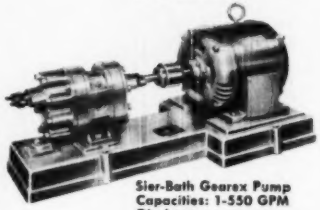
A **Cutler-Hammer** sales office is now located in Dayton, Ohio, at 410 W First St. P L Erickson will manage the office as a branch of the firm's Cincinnati district office. Another office is also opened at 109 S Warren St, Syracuse, N. Y. Operating as a branch of Buffalo office, Syracuse is assigned to cover the firm's accounts in the eastern half of Buffalo district.

(*Continued on page* 216)

SIER-BATH ROTARY PUMPS for uninterrupted service



Sier-Bath Screw Pump
Capacities: 1-700 GPM
Discharge:
1000 PSI for viscous liquids
250 PSI for water



Sier-Bath Gearex Pump
Capacities: 1-550 GPM
Discharge:
250 PSI for viscous liquids
50 PSI for water

Maintenance — not price — is the true measure of the cost of a rotary pump. That is why Sier-Bath Rotary Pumps are designed to provide uninterrupted, maintenance-free service.

Features that make Sier-Bath Screw Pumps and Gearex Pumps top performers at all times include:

No metallic contact between rotors.
External bearings for handling non-lubricating liquids.
Low pressure on stuffing boxes reduces packing maintenance.
Direct connected to motors at standard speeds up to 1800 RPM.
Available in corrosion-resistant alloys.

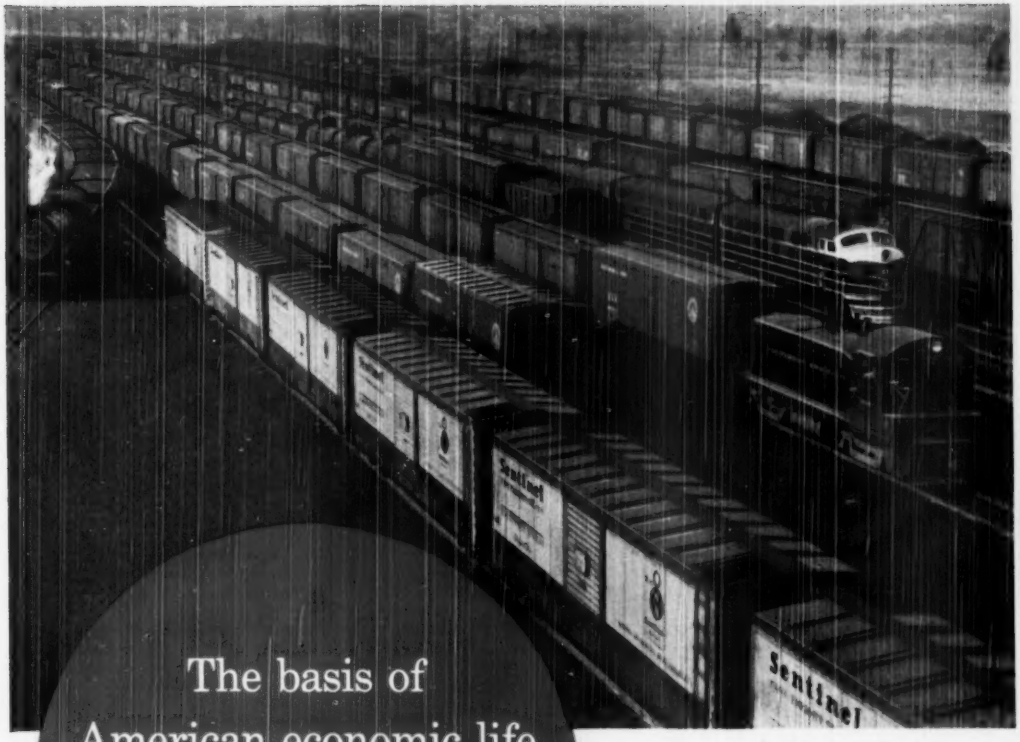
Write for descriptive bulletin.

Also manufacturers of Sier-Bath Precision Gears and Sier-Bath Gear Couplings.

FOUNDED 1905 MEMBER A.G.M.A.

Sier-Bath GEAR and PUMP CO., Inc.

9254 HUDSON BLVD., NORTH BERGEN, N. J.



The basis of American economic life is common-carrier transportation by rail—

the only form of transportation which can and does handle anything, anywhere, anytime, in any quantity, for anyone.

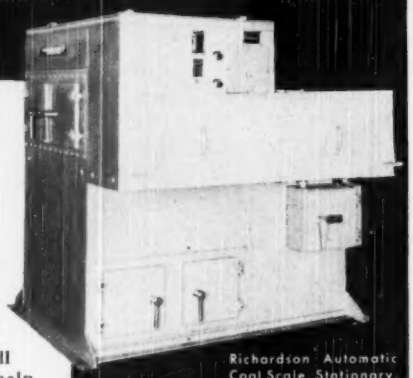
For such service at its best—Ask our man!

BALTIMORE & OHIO RAILROAD

Constantly *doing things* —better!

LINKING 13 GREAT STATES WITH THE NATION
B&O

KEEP YOUR B.E. UP
YOUR COAL COSTS DOWN...



Richardson Automatic Coal Scale, Stationary, Floor Mounted Style.

1 **Richardson Coal Scales**—Low B. E. (boiler efficiency) and costly coal waste are quickly signalled, the moment they begin, when you install a Richardson Coal Scale over each boiler. You get a detailed record of coal consumption by the hour, shift, day, week or month. By checking on all forms of coal waste they help to keep your power costs at a minimum!

Richardson "MONORATE" Distributor showing patented curved plate which prevents separation of lumps and fines.

2 **Richardson "Monorate" Distributors**—Designed by Richardson engineers for preventing coal segregation in stoker fired installations, the curved top plate of the "Monorate," causes all coal, *lumps and fines*, to fall at the same rate. It eliminates the tendency for the mixture to separate. This insures a uniform spread over your stoker hopper . . . a prerequisite for efficient combustion.

A complete Richardson Installation Provides:
Leakproof Gate from the bunker, Flexible Inlet to scale, Automatic Coal Scale, "Monorate" Non-Segregating Distributor to stoker or Down-take Chute to pulverizer.

Richardson engineers will be glad to discuss your coal consumption problems. For complete details on Richardson Coal Scales write for Bulletin No. 1143. Bulletin No. 1349-P gives complete information on the "Monorate."

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Atlanta • Boston • Buffalo • Chicago • Minneapolis • Wichita
New York • Omaha • Philadelphia • San Francisco • Houston
Montreal • Toronto • Cincinnati

Richardson

Materials handling by weight

6363

C E Bales has been elected president of **Ironton Fire Brick Co,** Ironton, Ohio. In addition, Robbins & Bohr, 535 Chattanooga Bank Bldg, Chattanooga, Tenn., has been chosen the company's representative in Tennessee.

Harold E Edlund joins **Arco Co** as director of sales. His headquarters will be in the firm's executive offices in Cleveland, Ohio.

American Brake Shoe Co has opened a sales office at 2620 Maury St, Houston, Texas. William C George has been appointed sales engineer in this territory and will represent Brake Shoe's American Manganese Steel, Electro-Alloys and National Bearing divisions in the new office. His activities will center in Oklahoma, Texas and Louisiana.

J A Shomer Co, 11201 Berea Rd, Cleveland 2, Ohio is distributor for **Morse Chain Co,** div of Borg-Warner Corp, in the Cleveland area.

Aquadyne Corp, New York City, has named Gloster P Hevenor executive vice-president.

W Herbert Hultgren is promoted to assistant chief engineer of **Purolator Products Inc,** Newark, N. J.

Ampco Metal Inc has chosen the following as distributors of Ampco centrifugal pumps in their respective areas: Walter H Eagen Co, Philadelphia; Kerr Machy Co, Detroit; Pump Engrg Co, Los Angeles; Johnson Engrg Co, Indianapolis; Diehl Pump & Supply Co., Louisville; Ramsay Pump & Supply Co, Pittsburgh; Westco Pump Sales Co, San Francisco; Truscott Co, Portland, Ore.; Southern Engine & Pump Co, Houston (branch sales offices in Dallas, San Antonio, Kilgore and Edinburg, Texas); McLellan A-C Supply Co, New Orleans; J J Heinrikson & Son, Kansas City, Mo.; Connecticut Pump Co, North Haven; Chase Pump & Equip Co. Providence; Ryan Hydraulic Specialties Co, Phoenix, Ariz.

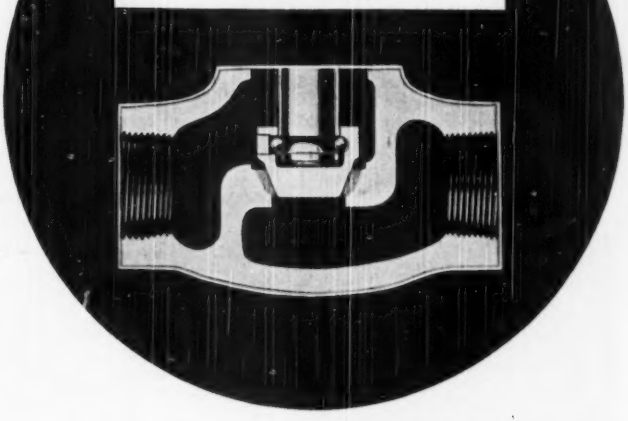
Allegheny Ludlum Steel Corp appoints Merle J Graham manager of production. His headquarters will be at Brackenridge, Pa. Frank G Benford succeeds Graham as plant manager of West Leechburg, Pa. plant. W R Yingst replaces Benford as assistant plant manager.

Charles B Belknap of Owens-Illinois Glass Co has been elected to board of directors of **Arthur D Little Inc,** Cambridge, Mass., research and engineering organization. Also, Howard J Billings succeeds Henry G Powning as treasurer. Billings will also be in charge of non-technical internal operations, formerly the responsibility of T L Wheeler, vice-president. Wheeler will shortly retire from the company under its regular retirement plan.

Nelson Stud-Welding Div of Morton Gregory Corp. of Lorain, Ohio, has released an 18-minute color sound movie entitled, "Split-Second Fastening."

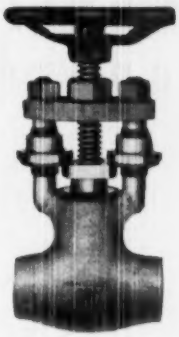
UNLIMITED SERVICE-LIFE
is just ONE ADVANTAGE *of*

HANCOCK INTEGRAL STELLITE SEATS



When you install **HANCOCK 600# WELDVALVES...**

Globe or Angle types—you are assured of freedom from valve seat leakage and replacement! For Hancock's integral stellite seats positively prevent leaks between body and seating surface, never need to be renewed! They guarantee valve service-life far beyond requirements of the equipment on which the valves are used.



HANCOCK WELDVALVES
give you these
PLUS FEATURES!

SUPERFINISHED "500 Brinell" stainless steel discs that eliminate wire drawing, steam cutting, erosion and corrosion.

•

POSITIVE BACK-SEATING by use of renewable polished stainless steel back-seating surfaces.

•

REAL STRENGTH in the upper structure—greater than in any conventional design.

•

CORROSION RESISTANCE of the exterior of the valve by special treating.

•

A STREAMLINED VALVE that allows close alignment of piping with near structures.

You can depend upon your Hancock Distributor for prompt service

MANNING MAXWELL & MOORE INC. TRADE MARK

HANCOCK *Valves*

1877 HANCOCK U.S.A.

A PRODUCT OF
MANNING, MAXWELL & MOORE, INC.
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Makers of 'Hancock' Valves, 'Ashcroft' Gauges, 'Consolidated' Safety and Relief Valves, 'American' Industrial and 'Microsen' Electrical Instruments. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load-Lifter' Hoists and other lifting specialties.

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Linings for

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BREECHINGS •

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FIREPROOFING •

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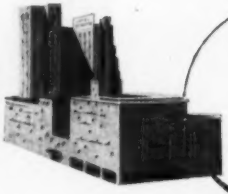
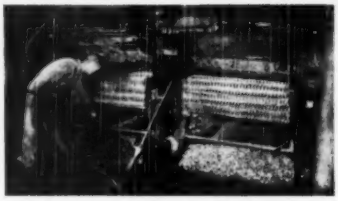
the first year

WITH

PEABODY OIL BURNERS



The Hotel St. George in Brooklyn *saved the cost of the entire installation* in less than one year by converting from coal to Peabody Oil Burners.

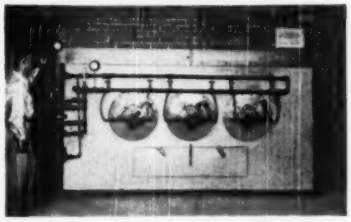


Before . . .

The St. George Hotel used 17,000 tons of bituminous coal a year to fire four 400-HP boilers operated at 75% efficiency. Conversion to oil was based on records dating back to 1928 and included *all* costs of operation.

After

Dirt and dust, along with coal bins and stokers, ash removal problems and maintenance expense, together with high labor costs, have been eliminated by Peabody oil burning equipment that fires these same boilers at 81% efficiency!



PEABODY PRODUCTS INCLUDE: *Automatic Gas and Oil Burners • Pump and Heater Sets • Direct Fired Air Heaters • Gas Scrubbers, Coolers and Absorbers • Burners, singly or in combination, for firing Oil, Pulverized Fuel, and Gas (manufactured, natural, refinery or blast furnace).*

509

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PEABODY
ENGINEERING CORPORATION
580 FIFTH AVENUE • NEW YORK 19, N. Y.

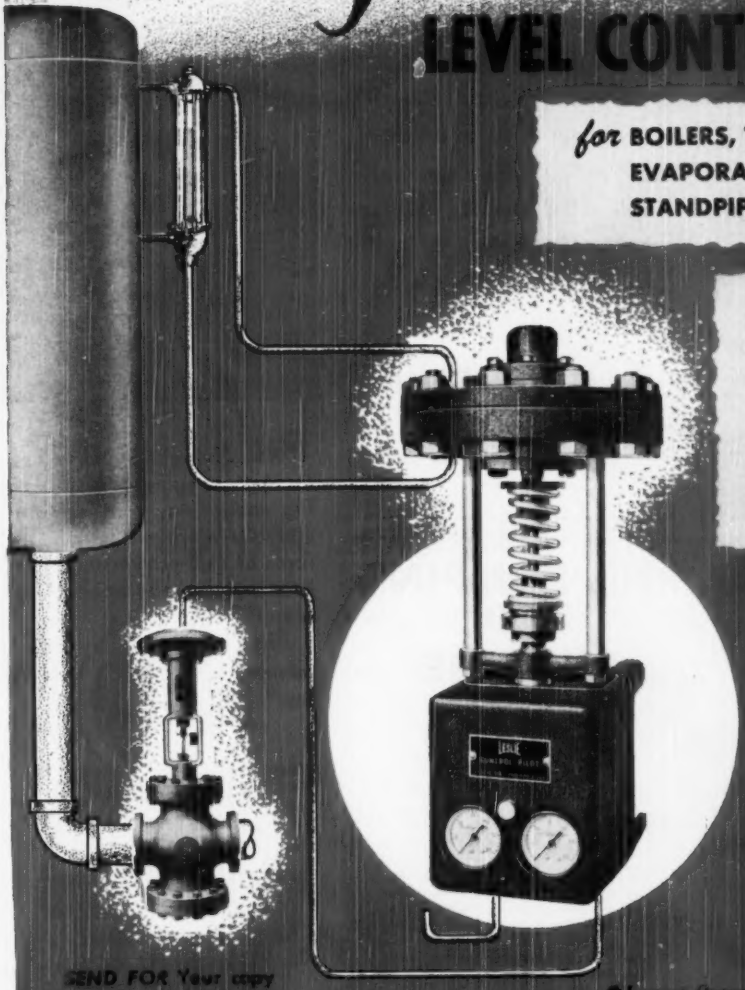
Manufacturers of all types of combustion equipment, direct-fired air heaters, gas scrubbers, coolers and absorbers

TRADE MARK

LESLIE *Floatless* LEVEL CONTROL

for **BOILERS, TANKS, EVAPORATORS, HEATERS, STANDPIPES, etc.**

A rugged, accurate control designed to overcome the limitations of floats, stuffing boxes, float cages, bellows, linkages, torque tubes, etc.



A simple solution to a troublesome problem

Lowest Overall Cost per Operating Year

SEND FOR Your copy of new LESLIE Floatless Level Control Leaflet.

ESTABLISHED 1900
LESLIE CO.
FIFTIETH ANNIVERSARY

Look for LESLIE REGULATORS under "Valves" or "Regulators" in your classified telephone directory in the following cities where LESLIE factory-trained engineers are located.

Albany, N. Y.	Cincinnati, Ohio	Indianapolis, Ind.	Mobile, Ala.	Ponca City, Okla.	Seattle, Wash.
Atlanta, Ga.	Cleveland, Ohio	Kansas City, Mo.	Monroe, La.	Portland, Ore.	Spokane, Wash.
Baltimore, Md.	Denver, Colo.	Kingsport, Tenn.	Montreal, Canada	Providence, R. I.	St. Louis, Mo.
Beaumont, Tex.	Detroit, Mich.	Los Angeles, Calif.	New Orleans, La.	Richmond, Va.	Syracuse, N. Y.
Birmingham, Ala.	Galveston, Tex.	Louisville, Ky.	New York, N. Y.	Rochester, N. Y.	Toronto, Canada
Boston, Mass.	Greensboro, N. C.	Memphis, Tenn.	Orlando, Fla.	Rutherford, N. J.	Vancouver, Canada
Bridgeport, Conn.	Greenville, S. C.	Milwaukee, Wis.	Philadelphia, Pa.	Salt Lake City, Utah	Wilkes-Barre, Pa.
Buffalo, N. Y.	Honolulu, Hawaii	Minneapolis, Minn.	Pittsburgh, Pa.	San Francisco, Calif.	Wilmington, Calif.
Chicago, Ill.	Houston, Texas			Savannah, Ga.	Youngstown, Ohio

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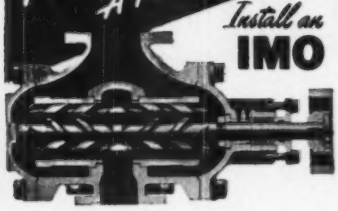
PRESSURE REDUCING VALVES • PUMP GOVERNORS • PRESSURE CONTROLLERS
TEMPERATURE REGULATORS • SELF CLEANING STRAINERS • LESLIE-TYFON WHISTLES

PULSATION A PROBLEM?

Install an IMO



With an IMO Pump delivery is not interrupted by the periodic strokes of a piston or the opening and closing of valves and ports. The turning of the rotors in an IMO forces the fluid from suction to discharge in a continuous, uniform flow.

IMO pumps can be furnished for practically any capacity and pressure required for oil, hydraulic-control fluids, other liquids.

Send for Bulletin I-145P

IMO PUMP DIVISION of the
DE LAVAL STEAM TURBINE CO.
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place the selection of the specific type in specialized hands . . . and obtain optimum efficiency.

Petro-Chem Development Company engineers are heating specialists . . . they can supply the whys and wherefores of indirect versus direct heating and the economics of both.

Every day more than 600, oil and gas fired, Petro-Chem Iso-Flow* installations in the petroleum, chemical and allied industries, demonstrate the efficiency of their design and installation.

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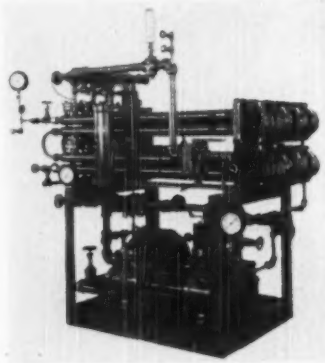
LOCKETT FUEL OIL PUMPING AND HEATING SETS *Custom Built*



The efficient, compact unit illustrated consists of one Worthington Duplex Steam Pump and one Electric Motor-Driven Rotary Pump, and three banks of Griscom-Russell Twin G-Fin Fuel Oil Heaters mounted on a single structural steel frame.

FOR almost a half century, Lockett has been supplying, to fit individual needs, efficient standard and custom-built Fuel Oil Pumping and Heating Sets, for mechanical and steam atomizing oil burners. Combinations of various types of pumps are available: Either two Turbine-driven Pumps; one Electric-driven and one Turbine-driven Rotary Pump; two Electric-driven Rotary Pumps; two Worthington Duplex Steam Pumps; or one Duplex Steam Pump and one Electric-driven Pump. Each pump is suitable for the full rated capacity of the unit; and one heater section is a spare. Lockett supplies everything, complete. *Inquiries are invited. Descriptive bulletins sent on request.*

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Safety Insured!

SAFETY insurance is a must on today's production line. That's why you invest in rigid steel conduit to guard vital electrical controls. You buy lifetime protection against damage by moisture, vapors, dust, vibration, shock and explosion. When you specify Buckeye you specify safety.

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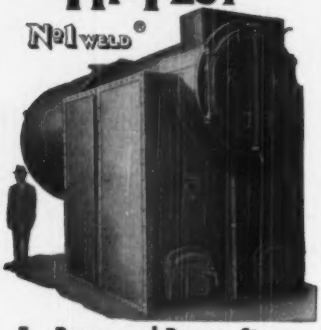
HI-TEST

No. 1 WELD



For Power and Process Steam

30 to 180 hp—125 and 150 lbs wp

Designed for easy handling, space saving and unusual economy . . . and built in full conformity with the ASME code for hi-pressure.

For any fuel . . . mechanically or hand-fired. Quickly and easily converted from one fuel to another.

WRITE Department 96-K3
for 6" scale with pipe diameter markings

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AT MODERATE INITIAL COST

100 TO 4000

HORSEPOWER RANGE

600# GA., 750° F.

STEAM PRESSURES

MURRAY

STEAM TURBINES

TYPE UV MULTISTAGE

The Type UV Multistage Turbine is available in from two to ten pressure stages making Multistage steam economy available at moderate initial cost. Horsepower range is from 100 to 4000, steam pressures up to 600# ga., 750° F., condensing or non-condensing. Several governors and accessories adapt UV Turbines to practically any mechanical drive within the capacity range.

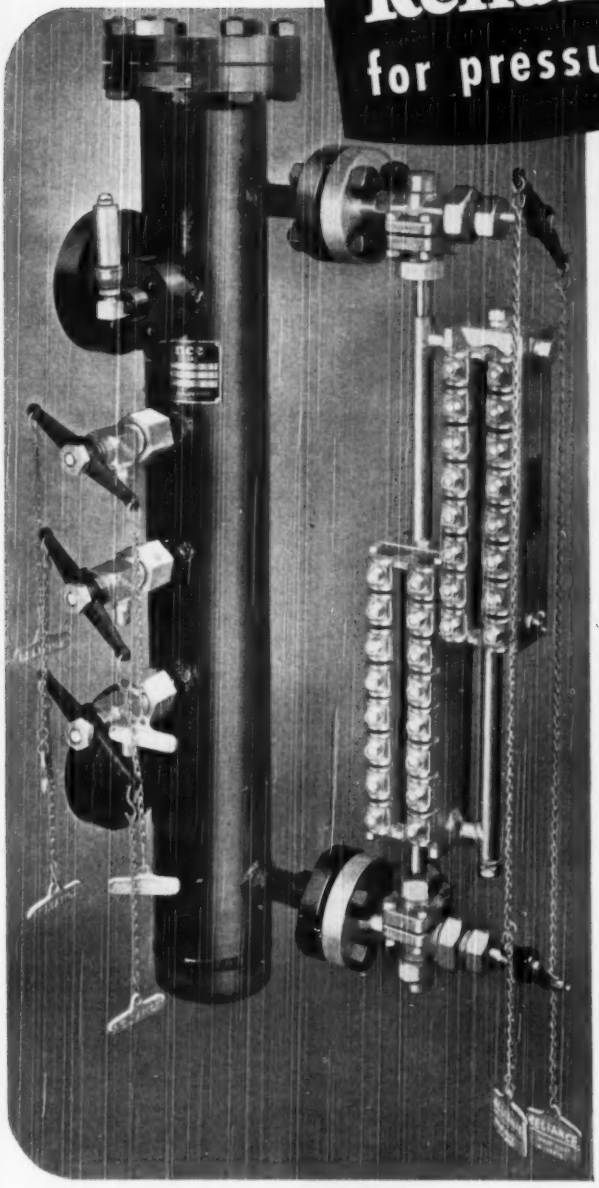
Pictured is a 5 Stage UV Turbine developing 325 HP at 6200 RPM operating condensing. Turbine is equipped with variable speed oil relay governor, pressure lubrication and vacuum breaker, and is in use driving a centrifugal compressor for refrigeration.

Contact your Murray representative for prices and engineering information or write for Bulletin T-122.

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA

BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

Reliance WM900
for pressures to 900 psi



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produced by the pioneer maker of Boiler Safety Devices to suit the needs of any type of boiler—any pressure.

Water Columns with alarms* sounding for high and low limit water levels—or low alarm only—or high alarm only. Water Columns without alarms. Standard and special designs. Single and twin gage assemblies. . . .*Those having alarms are equipped with sensitive, positive-acting float-operated alarm mechanisms that have been refined and improved during more than 65 years since Reliance introduced the first Water Columns so equipped.

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Reasonable First Cost
Low Upkeep

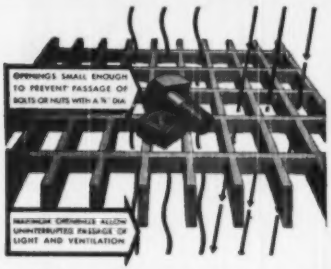
Write to the factory, or contact your nearest Reliance Representative, located in all principal cities.

THE RELIANCE GAUGE COLUMN CO.
5902 CARNEGIE AVENUE
CLEVELAND 3, OHIO

Boiler Safety Devices
Since 1884

Reliance®

TRI-LOK RECTANGULAR OPEN STEEL FLOORING


OPENINGS SMALL ENOUGH TO PREVENT PASSAGE OF BOLTS OR NUTS WITH A ¾" DIA.
MAXIMUM OPENINGS ALLOW UNINTERRUPTED PASSAGE OF LIGHT AND VENTILATION

Tri-Lok strength is obtained by truss action through twisted cross-bar, curved in opposite directions at each bearing-bar. Standard openings in Tri-Lok Rectangular Steel Flooring are 1" x 3⅞"—other size openings can be supplied as required.

Diagonal, or Super-Safety U-type Flooring, and stair treads of all types, are available. Bulletin KF 1140 describes the construction features of Tri-Lok Open Steel Flooring.

DRAVO CORPORATION

National Distributor for the Tri-Lok Company

Dravo Bldg., Pittsburgh 22, Pa.

Sales Representatives in Principal Cities

DRAVO

industrial
OIL AND GAS BURNING EQUIPMENT

- Mechanical Atomizing Oil Burners
- Steam Atomizing Oil Burners
- Refractory Burner and Muffle Blocks
- Industrial Gas Burners
- Low Air Pressure Oil Burners
- Fuel Oil Pump Sets
- Valves, Strainers, Furnace Windows
- Tandem Block Combustion Units
- Combination Gas and Oil Burners

Detailed information gladly sent you upon request.

NATIONAL AIROIL BURNER

NATIONAL AIROIL BURNER COMPANY INC.

1250 E. Sedgley Ave., Philadelphia 34, Pa.
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Check Your Paint-Stripping Problem HERE

- ☐ How can we strip baked-on primer coats without resorting to expensive thinners and solvents?
- ☐ Do you have a good idea that'll speed up the removal of toluene-thinned, asphalt-based paints from underground transformers?
- ☐ We've had a slew of armature coils in the shop for months, waiting for an economical way to strip insulating varnish . . . what do you have?
- ☐ Other headaches.

NAME.....
ADDRESS.....
COMPANY.....

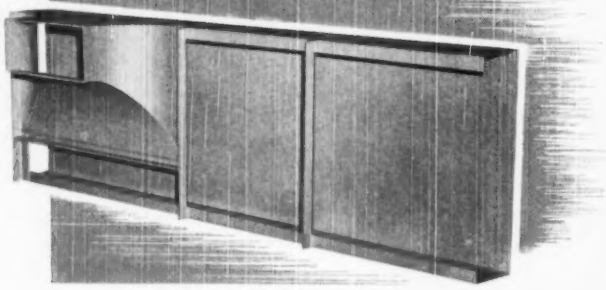
Power plant paint-stripping can be done easily and quickly if the proper stripping compound is selected—then applied as recommended. Take transformer stripping, for example. Your nearby Oakite Technical Service Representative can show you a number of job-proved methods, including hot flow-on, cold spray, steam-gun and tank-immersion techniques. He'll help you select the Oakite method best suited to your lay-out . . . help you find a simple way to save time and money on the job.

Let us have your paint-stripping problems (whatever they might be). We'll ask the Oakite Technical Service Representative in your vicinity to visit your plant and talk them over with you. Or, if you'd like to have some factual data about fast Oakite paint-stripping procedures first, send for a complimentary copy of the Oakite Power Plant Digest of 71 maintenance-cleaning procedures. Oakite Products, Inc., 23 Thames St., New York 6, N. Y.

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS • METHODS • SERVICE
Technical Service Representatives Located in Principal Cities of United States and Canada

Don't Gamble....

GET PRICE AND QUALITY IN LITTLEFORD FABRICATION



You get superior work because Littleford for 68 years has been fabricating power house equipment, large jobs and small, in any quantity, in any weight or kind of metal. You win by our unusual facilities and skilled craftsmanship. You pay for no trial and error at Littleford, because we really know how! Send specifications and let us quote on your next job.

FABRICATORS OF PLATE AND SHEET METALS
LITTLEFORD
LITTLEFORD BROS., INC.
438 E. Pearl St., Cincinnati 2, Ohio

DUCT WORK—BREECHINGS
ELECTRICAL ENCLOSURES
TRANSFORMER HOUSINGS AND TANKS
CONTROL DESKS AND INSTRUMENT PANELS
CUBICLES—PIPING—CABLE PANS

Only A. O. Smith gives you **ONE** source of

UNDIVIDED RESPONSIBILITY

with SMITHway Vertical Turbine Pumps

All major pump parts of A.O.Smith Pumps are designed together, built together, to *work* together—your assurance of years of dependable, low-cost service.

When you choose an A. O. Smith Pump, you know it is *all* A. O. Smith from motor to strainer—SMITHway all the way down. You can be sure that the sum of A. O. Smith's 76 years of experience has been engineered into *every* pump part, to give you a superiority you can depend on under the toughest operating conditions.

Weight Where Weight Belongs. A. O. Smith discharge-head assemblies are built of heavy steel plate, formed and welded into the strongest, most compact design. Support for the driver and suspended assemblies is rigid, vibrationless, yet easily accessible.

Bowls are precision-machined from hard, close-grained cast iron, fitted with smooth, streamlined diffusion vanes contoured for maximum efficiency. Bronze impellers, closed or semi-open, are dynamically and hydraulically balanced.

"Tailor-Made" for Each Job. Complete interchangeability of major assemblies lets you select the right combination of driver, column pipe, lubrication, and impeller to fit each pumping application. You have an application-engineered pump exactly right for each job.

Send the coupon for complete information!

CERTAIN DISTRIBUTOR TERRITORIES for SMITHway Pumps are still available. Write for full details telling you all about the SMITHway Vertical Turbine Pump franchise. Send the coupon below for our colorful descriptive bulletin.

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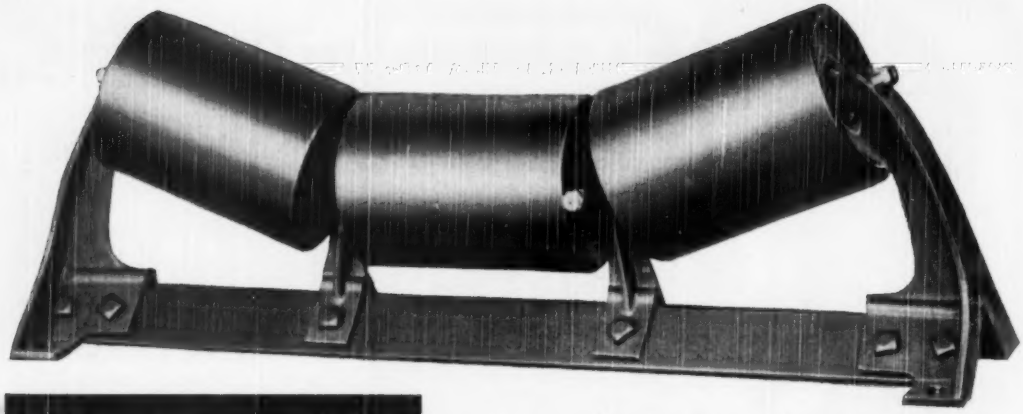
A. O. Smith Corporation, Dept. P-350
Milwaukee 1, Wisconsin

Without obligation, send us your illustrated descriptive bulletin on Smithway Vertical Turbine Pumps.

Name _____

Street or Route _____ Box _____

City _____ State _____



GIVE IT A RIDE— ON JEFFREY BELT IDLERS

Costs must be cut. No question about that . . . and no question about the economy of Jeffrey Belt Conveyors when small or large quantities of material must be handled. We can furnish them by the rod, or mile, just as the job requires. We know how to provide for reliability under tough conditions, handling of peak loads, low investment, high salvage and other things which are problems peculiar to engineering.

Hence, we say, "Give That Material A Ride on Jeffrey Idlers." They are the backbone of the belt conveyor . . . have been the choice of smart operators on thousands of jobs. They are built to take day-after-day punishment . . . have that reserve strength and durability that count for many years of satisfactory, efficient trouble-free service.

Whether yardage looms large in the estimate, or small capacity is desired, Jeffrey engineers are skilled in the application of material handling to most any job. We would like to talk things over—constructively.

Catalog No. 785 Tells All

Self-aligning, Troughing-type Belt Idler

Pivotly mounted on a supporting cross member, guide rollers are mounted on arms and extend at right angles to idler. Need only to be spaced about 20 to 50 feet apart to keep belt in perfect alignment. Will not damage belt.

Pivoted-type Return Idler

Used for both troughing and flat belt conveyors. Of the self-aligning, two-pulley type. Also standard return rolls pivotly mounted in ball bearings on supporting cross member. Write for full details about Jeffrey Idlers for either troughing or flat belt service.

THE JEFFREY MANUFACTURING COMPANY

Established 1877

932 North Fourth St., Columbus 16, Ohio

Complete Line of Material Handling, Processing and Mining Equipment

JM

Baltimore 2	Chicago 1	Detroit 13	Jacksonville 2	Pittsburgh 22
Birmingham 3	Cincinnati 2	Harlan	Milwaukee 2	St. Louis 1
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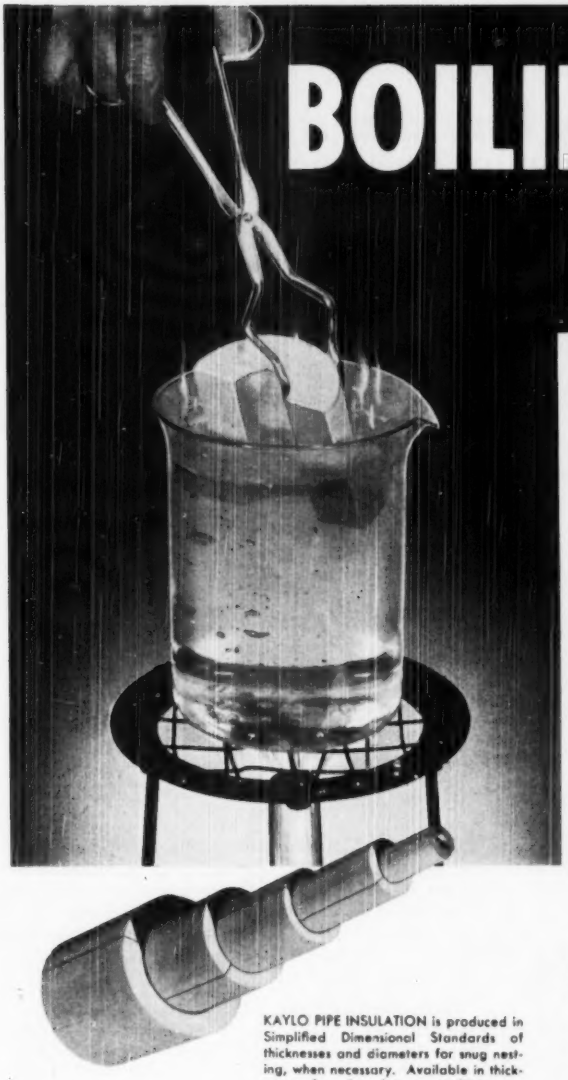
Buffalo 2	Denver 2	Huntington 19	Philadelphia 3	Scranton 3

Jeffrey Mfg. Co., Ltd., Head Office & Works: Montreal

BOILING TEST

PROVES STABILITY OF KAYLO HEAT INSULATION



KAYLO PIPE INSULATION is produced in Simplified Dimensional Standards of thicknesses and diameters for snug nesting, when necessary. Available in thicknesses from 1 to 3 inches in 36-in. sections, for pipe sizes from ½ to 12 in.

What insulation material will not break down under exposure to live steam or hot liquid? Answer: Kaylo Heat Insulation.

In tests, samples of Kaylo Heat Insulation have been boiled continuously for 24 hours and longer. None has disintegrated or shown any loss of insulating efficiency, after drying. Test boiling has caused no appreciable shrinking, swelling, weight loss or permanent change in Kaylo Heat Insulation.

This Inorganic Material Insulates Efficiently From 200° F. to 1200° F.

One layer of Kaylo Heat Insulation assures you of insulating efficiency from 200°F. to 1200°F.—a temperature range which often requires two thicknesses of different materials . . . and the efficiency of Kaylo insulation actually improves after exposure to service temperatures.

This remarkable new product is available in two forms: Kaylo Heat Insulating Block and Kaylo Pipe Covering. Both are exceptionally strong, lightweight and resistant to moisture damage . . . easy to handle and apply . . . neat and clean in appearance on finished jobs.

The many advantages offered by Kaylo Heat Insulation are appreciated by users in many different industries.

KAYLO®

HEAT INSULATING BLOCK and PIPE COVERING

OWENS-ILLINOIS GLASS COMPANY
Kaylo Division • Toledo 1, Ohio

SALES OFFICES:
Atlanta • Boston • Buffalo • Chicago • Cincinnati • Dallas • Minneapolis
New York • Philadelphia • Pittsburgh • St. Louis • Toledo • Washington

SEND COUPON FOR KAYLO HEAT INSULATION SAMPLE & LITERATURE

OWENS-ILLINOIS GLASS COMPANY
Dept. N-72, Kaylo Division · Toledo 1, Ohio

Gentlemen: Please send me a Kaylo Heat Insulation sample and descriptive literature.

NAME.....

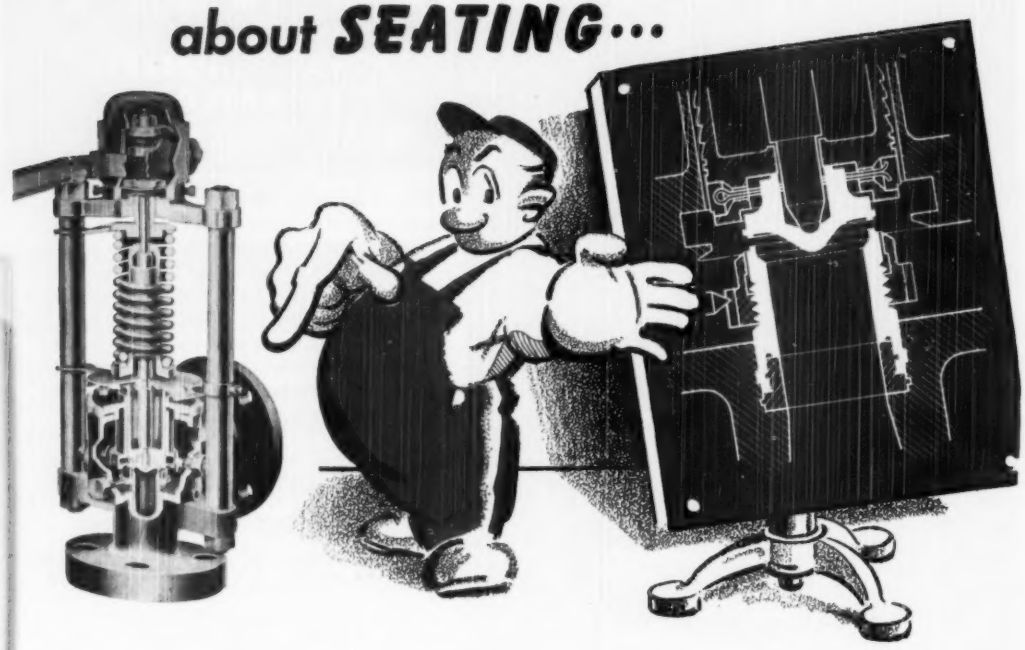
FIRM.....

ADDRESS.....

CITY.....STATE.....

We Studied SAFETY VALVE LEAKAGE

— Here's what we found out about SEATING...



We found — what most power plant men already know...that in order to be tight, a safety valve must have matched, wear resistant, corrosion resistant seating surfaces, and that the disc must seat square.

We found — what power plant men have long suspected...that uneven expansion, causing dragging of one seating surface over the other, can destroy the seat so completely that the safety valve has to be overhauled or replaced, even though it has never been popped.

We found ...that when nozzle and disc are made of alloys with the same coefficient of expansion, and with sections designed so that their rate of heat absorption is the same, destructive drag is eliminated. This is one of the basic features of the Gentzel Design, and is the reason Foster 38-SV Safety Valves can be guaranteed to stay tight.

To you ...this means elimination of costly boiler outage due to safety valve leakage. Other guaranteed *and* proven advantages are...consistently accurate popping ...minimum blow-down, which can be held to as little as 1%...highest relief capacity for a given nominal valve size...and extremely low maintenance.

One Executive of a large Eastern Utility put it this way, "Leakage is a serious item. Every time we have to shut down for leaky safety valves, we tie up several million dollars worth of equipment. It costs us thousands of dollars a day."... The Superintendent of a mid-west generating station said, "My Foster 38-SV's are the only safety valves I have that don't leak."

Foster 38-SV Gentzel Design Safety Valves are made for pressures as low as 35 pounds as well as for pressures in excess of 2500 pounds. For details on the design and construction features that enable this valve to outperform ANY other safety valve... and for a list of installations near you, get in touch with your Foster Representative or with us direct.

FOSTER ENGINEERING Company

PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS... PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

835 LEHIGH AVENUE • UNION, N. J.

(Partial view of the enormous new lubricating oil plant at Lake Charles, La., where this great new oil is processed.)

"ANTI-FOULING" OIL made by the Remarkable new "HEART-CUT" PROCESS

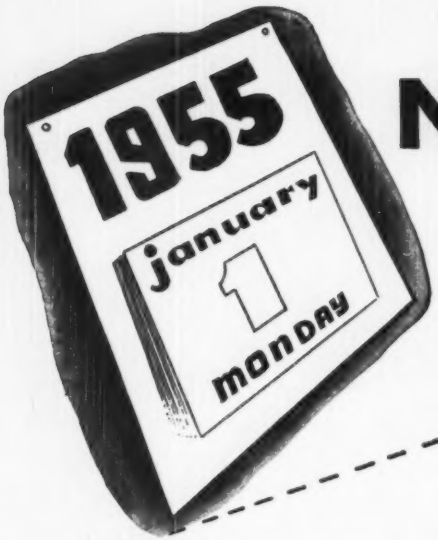
This new oil—the best known to science... gives you a cleaner engine... more economy ...minimum carbon residue.

It's here now! The remarkable motor oil from the giant new $42,000,000 lubricating oil plant at Lake Charles, La. The plant that's been the big talk of the oil industry for months.

New Premium Koolmotor is made by the unique "Heart-Cut" Process which retains only the choicest part of the finest crudes. *It's so superior that in recent engine tests it outscored nine other major premium motor oils.* No wonder Premium Koolmotor is better in every way! Cleans better, seals better, cools better and fights acid, sludge and corrosion far more effectively. Switch to this remarkable new oil today.

start saving Dollars today... stop at

CITIES SERVICE



No, not yet, but....

MARLEY FANS, GEAREDUCERS, DRIVE SHAFTS AND FAN CYLINDERS ARE *FIVE YEARS AHEAD* IN THE FIELD OF COOLING EQUIPMENT . . . since, the HEART of any Cooling tower or DriCooler is these mechanical units, their dependability and performance are of the utmost importance.

Just imagine mechanical equipment of any type . . . particularly 22 foot fans powered by 75 brake horsepower . . . operating 24 hours a day in the midst of a hot, dank jungle! Yet, this is the atmospheric condition under which mechanical units must perform on water cooling equipment.

Recognizing this fact, and realizing that commercial-type equipment was not available to meet these severe conditions, The Marley Company, Inc., decided in the early thirties to design and produce their own.

Today, Marley offers newly designed Geareducers, fans, fan cylinders and drive shafts . . . developed not from theory, not from a few scattered tests over one or two years' time, but backed with the "know-how" gained from MORE THAN 5000 UNITS actually in operation over the past fifteen years! This is 5 TIMES THE EXPERIENCE OF ANY OTHER manufacturer.

Of course, your next Marley DriCooler or Cooling Tower will have this "years ahead" mechanical equipment. But, you can modernize your present installation, if you wish, with Marley mechanical equipment which is now available in a range of sizes to fit most any cooling unit.

If you would like to know more about Cooling Tower or DriCooler Operation, Maintenance, Testing, Water Distribution, Specifications, Water Treatment, Air Movement, and other vitally important cooling problems, MAIL THE COUPON or write today for free, illustrated folders.

MAIL THIS COUPON TODAY

The Marley Company, Inc., Kansas City 15, Kansas P-8

☐ Yes, I would like to have your FREE, illustrated folders on cooling problems.

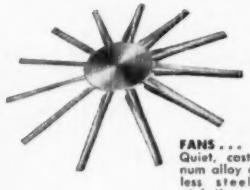
☐ Please have salesman call to discuss our cooling problem.

Name_____ Title_____

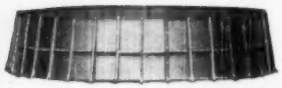
Company_____

Street Address_____

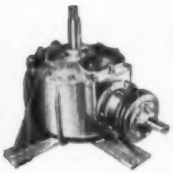
City_____ State_____



FANS . . . Quiet, cast aluminum alloy or stainless steel, true airfoil sections, adjustable pitch, smooth, efficient, balanced.

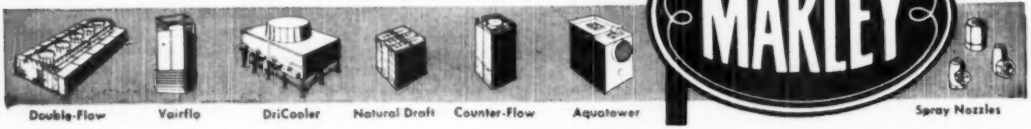


FAN CYLINDERS . all bolted construction (not nailed together) tapered throat, non-corrosive materials, high enough for safety, low enough for easy inspection, sized to give close fan tip clearance.



GEAREDUCERS . . . heavy cast iron cases, case hardened nickel-moly steel gears, Parco lubrized pinions, positive lubrication forward and reverse, sized and geared to meet operating horsepower.

DRIVE SHAFTS . . . Heavy tubular steel with integral yokes, flex-disc couplings, balanced for smooth operation, do not require lubrication.

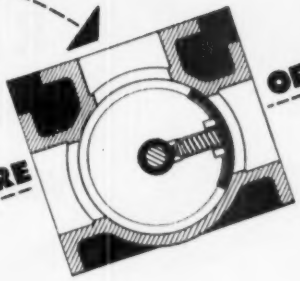


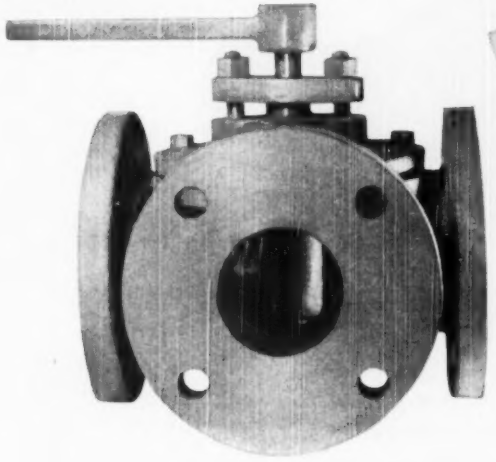
MARLEY

BRING YOUR FLUID IN HERE

OR HERE . . .

AND LET IT COME OUT HERE





with this amazingly simple

HONEYWELL TRANSFER VALVE

HERE is true simplicity . . . sturdy, practical, efficient. A minimum of parts in this Honeywell Transfer Valve makes it easy to maintain, easy to clean. (Complete disassembly requires only the removal of four nuts.)

If the fluid to be diverted is thick, or if it carries suspended solids . . . investigate this Honeywell Transfer Valve. It saves money, too . . . often replacing two gate valves and associated fittings. Available in Cast Iron, Bronze, and Galvanized Cast Iron, with Bronze, Iron, or Monel trim. Sizes 2" and up—two way or straight through—screwed or flanged.

Call in your local Honeywell engineer for detailed information about this valve or such other Honeywell Control Specialties as Hi-Lift Hand Control Valves, Liquid Level Devices, Steam-Jacketed Rotary Cocks, and the Honeywell Space-Saving Bypass.

COMMERCIAL • RESIDENTIAL • INDUSTRIAL
WORLD'S LARGEST ORGANIZATION FOR ADVANCED INSTRUMENTATION AND CONTROL

MINNEAPOLIS-HONEYWELL REGULATOR CO.
INDUSTRIAL VALVE DIVISION
1900 Windrim Avenue, Philadelphia 44, Pa.
Offices in 77 principal cities of the United States, Canada and throughout the world

Honeywell PROCESS CONTROL SPECIALTIES

R/M no. 303
a high-temperature valve stem packing

R/M No. 303 is specifically designed for use on valve stems and in expansion joints handling superheated steam or hot gases at temperatures up to 900°F. The core is of large graphite particles which are not affected by heat, but which provide the necessary compressibility. A jacket of pure asbestos yarns, reinforced with Monel wire, is braided over the core and treated with a high-temperature, non-fluid type of binder. The outer surface is finished with flake graphite.

RAYBESTOS-MANHATTAN, INC.

PACKING DIVISION, MANHEIM, PA.

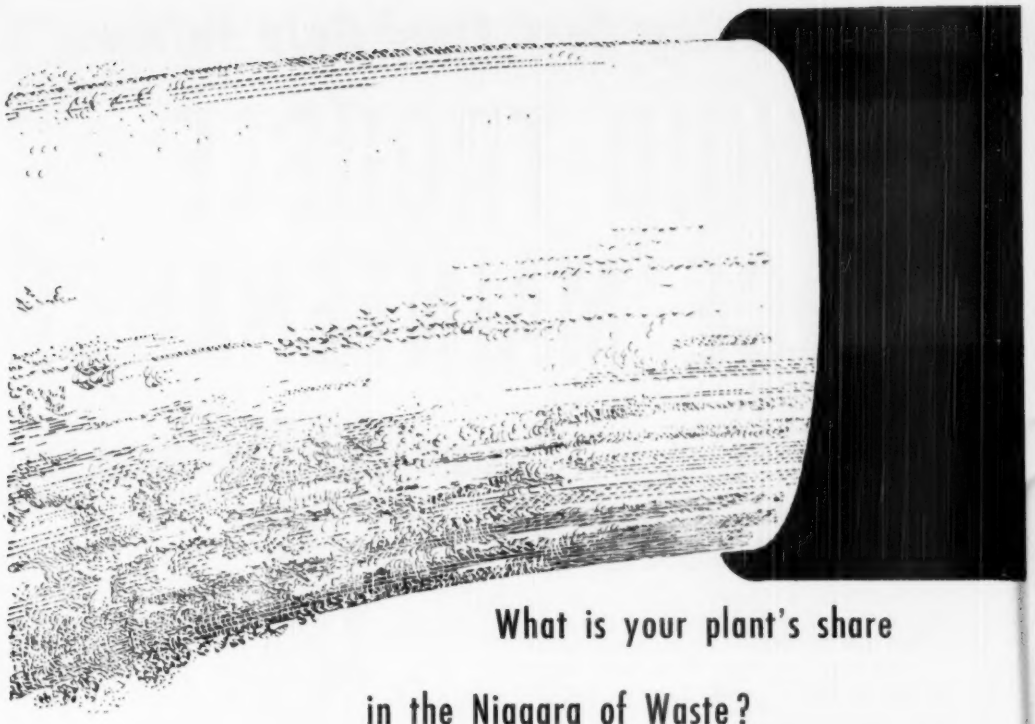
FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles • Mechanical Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks Clutch Facings • Fan Belts • Radiator Hose • Powdered Metal Products • Bowling Balls

Raybestos-Manhattan, Inc. P-30
Packing Division, Manheim, Pa.
Gentlemen: Please send me data on R/M No. 303.

Name _____
Position _____
Company _____
Address _____
City _____ Zone ____ State _____

R/M



What is your plant's share in the Niagara of Waste?

Every working day, industrial plants discharge many times as much water as flows over Niagara Falls.

Since most of this water is returned to streams or to the ground and is available for further use, it isn't "wasted" in the usual sense. To the individual plant, throwing it away, it *is* waste. The plant paid for it, paid to make it fit for plant uses, and must pay again to treat it so that it will not pollute the streams into which it is discharged.

In many plants, too, it is waste in still another sense, for a significant portion of it represents totally unnecessary consumption.

Reduction of such unnecessary water consumption is part of Hall Service. Thus, in one textile plant where Hall was called into consultation on plans for treatment of effluent water, the first step was to study water *use*. It was discovered that water consumption per unit of output had quadrupled over a period of years. Finding the sources of that increase and reducing consumption to normal not only cut the cost of treating the effluent but also effected a substantial saving in expenditures for water.

Over-consumption of water may not be a problem in your plant, but if you are concerned in any way with the industrial use of water, you will be interested in the new Hall bulletin "Let's Consider Your *Whole* Water Problem." May we send you a copy? Hall Laboratories Inc., Hagan Building, Pittsburgh 30, Pa.

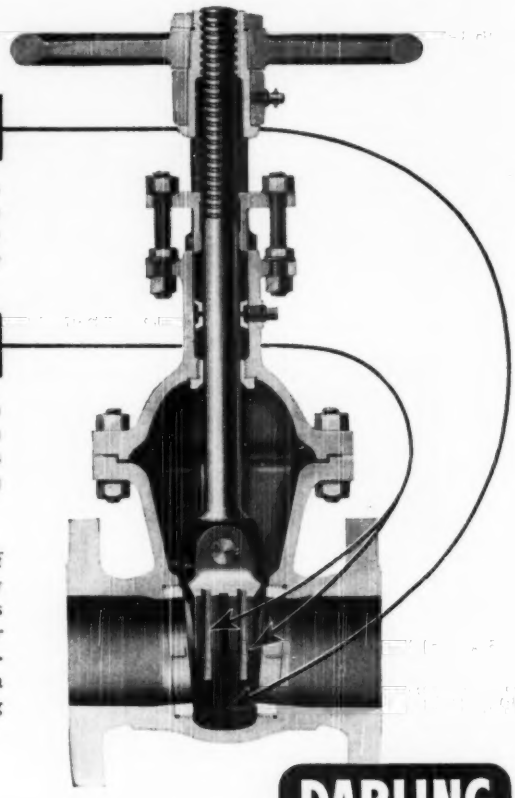
HALL *plant-wide* WATER SERVICE

BOILER WATER CONDITIONING

PROCUREMENT, TREATMENT, USAGE AND DISPOSAL OF INDUSTRIAL WATER

How Darling Cast Steel Gate Valves

AVOID TROUBLE
REDUCE MAINTENANCE



SLOTTED WEDGE

Allows compression of the wedge. Compensates for valve body expansion or contraction due to temperature changes. Thus tight closing and easy opening are assured, with far less wear and tear on wedge faces and seats.

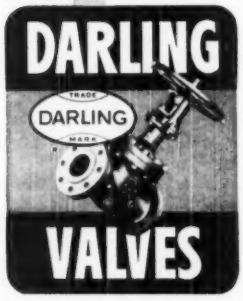
DOUBLE-GROOVED WEDGE

Double grooves, with corresponding twin ribs in valve body, provide twice the usual bearing area for lasting, trouble-free alignment. Eliminates wedge canting, due to line pressure, preventing damage to downstream seat.

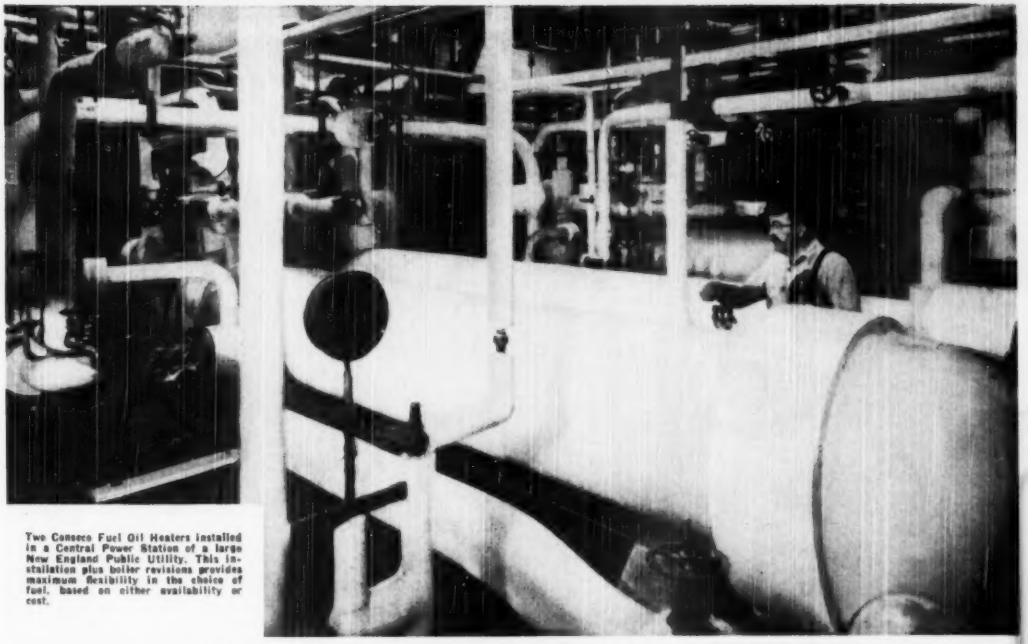
These are only two of the many "ounces of prevention" built into Darling valves. They always add up to gate valve performance at its low-cost best! Give Darlings a chance in *your* service and you'll see for yourself. The 300-page Darling Catalog No. 17M, full of data of general value and description of Darling valves of *all* types, is yours for the asking.

Darling Gate Valves, noted for outstanding quality, strength and precision, are made in a wide range of sizes, types and constructions for all kinds of normal and unusual service . . . and for pressures up to 1500 pounds. In addition to the slotted wedge types, there are solid wedge taper seat valves and the famous Darling Fully Revolving Double Disc Parallel Seat Gate Valves for virtually any service.

DARLING VALVE
AND MANUFACTURING CO.
WILLIAMSPORT 8, PA.



THE VALVE MARK OF QUALITY . . . WATCH FOR IT



Two Conseco Fuel Oil Heaters installed in a Central Power Station of a large New England Public Utility. This installation plus boiler revisions provides maximum flexibility in the choice of fuel, based on either availability or cost.

Eliminate Coal Strike Headaches!

BOILERS

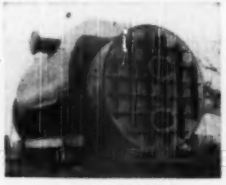
Also:

CLOSED HEATERS

DEAERATORS

EVAPORATORS

STEAM JET AIR EJECTORS



CONDENSERS

Be prepared to instantly fire with oil by installing Conseco Fuel Oil Heaters. Plants with oil and coal combustion systems can take advantage of lower price of either fuel.

Conseco's Edgemoor Iron Works Division will plan and execute whatever changes may be necessary to coal fired boilers to adapt them to the use of coal, oil or gas.

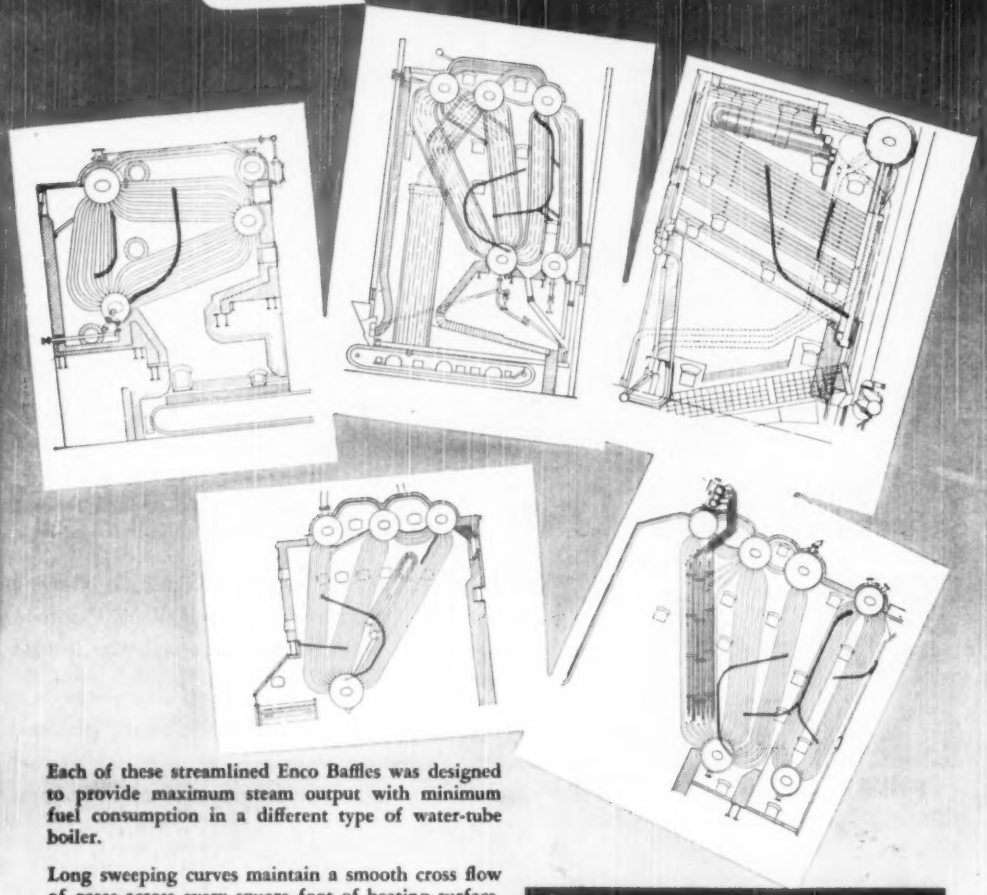
CONSECO Engineers are at your command to design and build condenser and heat exchanger equipment to your requirements and guaranteed to meet or exceed performance specifications.

CONSECO

Condenser Service & Engineering Co.

HOBOKEN, N.J.

Streamlined for Savings
IN EVERY TYPE OF BOILER



Each of these streamlined Enco Baffles was designed to provide maximum steam output with minimum fuel consumption in a different type of water-tube boiler.

Long sweeping curves maintain a smooth cross flow of gases across every square foot of heating surface. Eddy currents, bottlenecks and dead gas pockets are eliminated—draft losses are cut to a minimum. Soot blowers work more effectively, less steam and less time are needed for cleaning.

Enco Streamline Baffles are individually designed and engineered to the exact requirements of your boiler. Experienced Enco-trained crews take charge of the installation.

The 18-page Enco Bulletin, BW44, shows how engineers throughout industry have gotten higher boiler efficiency and increased steam production through the use of Enco Streamline Baffles. Why not write for your FREE copy today?

The Engineer Company Produces:

ENCO OIL BURNERS

ENCO FUEL OIL PUMPING AND HEATING UNITS

ENCO AUTOMATIC OIL-ELECTRIC IGNITION SYSTEM

ENCO AUTOMATIC COMBUSTION CONTROL

THE ENGINEER COMPANY

75 WEST STREET, NEW YORK 6, N. Y.

Canadian Representative:

F. J. Raskin, Ltd., 370 Rachel E., Montreal, P. Q.

EC-473

are **coil failures** *costing you money?*

look at this record!

18 *failures in 8 years with regular insulation*

Date	Cause of Failure
2/21/40	Armature coils grounded
12/29/40	Armature coils grounded
9/2/41	Open armature circuit
4/13/42	Armature coils grounded
4/18/42	Leads loose in commutator
10/24/42	Armature band thrown
4/5/43	Armature coils grounded
8/9/43	Open armature circuit
10/7/43	Armature coils grounded
9/30/44	Armature coils grounded
10/18/44	Armature coils grounded
7/28/45	Armature coils grounded
9/14/46	Armature coils grounded
2/6/47	Armature coils grounded
6/23/47	Armature coils grounded
9/17/47	Armature coils grounded
11/4/47	Armature band thrown
12/26/47	Armature coils grounded

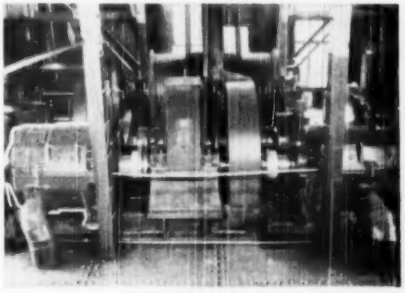
NOT 1 *coil failure in 2 years with National special class H coils*

"Still operating beautifully," is the report *two years after installation* on the National silicone-glass-mica armature coils of the motor shown above. They were installed January 7, 1948, in the National shop. That's quite a record, following the 18 failures in 8 years listed at the right above.

The motor is, of necessity, subjected to terrific abuse, since it is a hoist motor on a huge coal stripping shovel which often bites into solid rock. Excess heat burned out the coils monotonously . . . until National installed the special coils.

Special National Class H coils such as these are building up amazing records wherever high heat is a problem. They utilize silicone, melamine, glass, mica, MICA-GLAS, high-heat varnishes, special solders and other inorganic materials. The insulating materials are made in our plant to our rigid specifications. And all National coils fit snug and tight. They last.

Many armature burn-outs can be avoided by the use of higher grades of insulation. However, all-inorganic insulation isn't always the entire answer. Improved ventilation, better heat conductivity and other factors are also of importance. Your nearby National Field Engineer knows. Write for his name.



Part of the interior of the strip shovel is shown above. The motor outlined is the one which caused so much trouble and expense before National special Class H coils were installed. A larger view of the same motor is shown in the photo at the upper left.

NATIONAL ELECTRIC COIL COMPANY

COLUMBUS 16, OHIO, U. S. A.

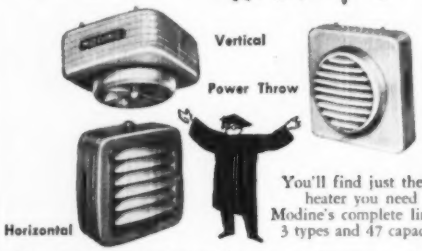
ELECTRICAL ENGINEERS MAKERS OF ELECTRICAL COILS AND INSULATION

DESIGNERS AND REPAIRERS OF ROTATING ELECTRICAL MACHINES

What makes the difference in Unit Heaters?

DISCHARGE AIR TEMPERATURE*

Mibs shooter or stilt walker — you're comfortable either way if Modine Unit Heaters supply the heat. Modine's *right* combination of correct outlet temperature and sufficient air velocity heats all parts of a room uniformly, even in coldest weather.



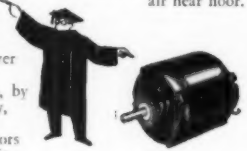
You'll find just the unit heater you need from Modine's complete line of 3 types and 47 capacities.

**For maximum comfort and lowest operating cost, temperature of air leaving unit heater should be between 110°-120°F. at standard conditions.*

LOWER COSTS

Fuel bills drop when you heat with Modine Unit Heaters. Modine's sufficient air velocity and correctly related outlet temperatures combine to deliver heat down into comfort zones where it's needed . . . don't waste it on ceilings or above heads of room occupants.

Built-in velocity generator increases heat throw *without increasing power costs* . . . lets large share of warm outlet air disperse cold air near floor.



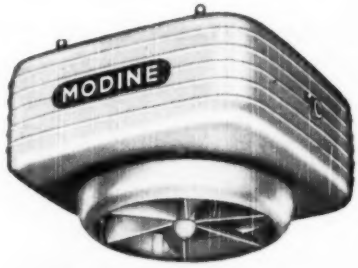
Modine gives you lower power and motor maintenance costs, too, by using only high-quality, totally enclosed split-phase or capacitor motors on all but smallest unit heater models.

LONGER LIFE

Modine Unit Heaters last longer. One exclusive feature, Parker-Bonderizing, protects casings and sheet metal parts against formation and spread of rust . . . anchors paint to steel . . . prolongs original attractive finish.

Entire condenser of pure copper and copper alloy gives you maximum resistance to electrolysis and corrosion.

Controlled brazing results in one-piece, integrated coil construction, eliminating all weak spots. What's more, Modines have no screwed or expanded joints, no gaskets or bolts.



Modine
UNIT HEATERS

Yes . . . look beyond BTUs when buying Unit Heaters. Look to Modine! You can get all the facts by calling your nearest Modine Representative. He's listed in the classified section of your phone book. Or write direct. Modine Mfg. Co., 1512 Dekoven Ave., Racine, Wisconsin.

Ask for the new Modine Unit Heater Bulletin 149-A. Also available on special request is the informative booklet — "Here's How to Evaluate Operating Characteristics of Suspended Unit Heaters." Send for them today!

U-1043

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Controls to Lengthen Life

of Condenser and Heat Exchanger Tubes

Although the selection of the correct alloy for tubes in heat exchangers is of vital importance, especially under circumstances which produce highly corrosive conditions, the protection of these tubes from foreign matter and during storage is also essential.

The information listed below, although previously published in separate articles in the Copper Alloy Bulletin, may provide a speedy check list for the engineer looking for ways of increasing tube life.

Suggested Record Form

Accurate records provide valuable information when the time comes for retubing of equipment. They are also of great value in analyzing reasons for premature failure.

1. Length of time tubes have been in service.
2. History of tube performance in this condenser and adjacent ones.
3. Type of condenser.
4. Temperatures, velocities, and pressure.
5. Elevation of condenser in relation to intake.
6. Operating schedule.
7. Frequency of cleaning and type of debris found.
8. Evidence and nature of pollution.
9. Location of condenser and nature of cooling water.
10. Composition of cooling water.

Controlling Foreign Matter

Since foreign matter is partly responsible for damage and corrosion, it is obvious that its entrance into the heat exchanger should be prevented in so far as possible by:

1. Long intake tunnels or channels which allow much foreign matter to settle out before it reaches the condensers.
2. Baffles in intake tunnels which are an effective means of keeping floating debris from entering the plant.
3. Stationary and rotating screens, which are desirable for keeping out such foreign matter as stones, shells, cinders, etc.
4. Dredge channel and keep intake tunnel clean.
5. Use screens fine enough to prevent debris from entering the condenser tubes.
6. Clean out water box, keep paint intact.
7. Clean out tubes regularly with high pressure air or water applied at the exit end. The pushing of rubber plugs through the tubes is also effective. Do not use wire brushes.
8. Flush tubes with clean water when possible.
9. If troubled with marine growth, investigate possibilities of using chlorination.

Cleaning Methods

Cleaning methods for heat exchange tubes vary from plant to plant and generally fall into the categories listed below:

A. Manual or mechanical methods for removal of silt, slime, debris and large fouling organisms.
   1. Hand removal of debris and "rodding".
   2. "Shooting" rubber plugs, brushes and scrapers.
   3. Jetting with water or water-air or water sand.
   4. Drying with hot air.

B. Control of fouling or deposits
   1. Screening
   2. Chlorination
   3. Increasing water velocity
   4. Heating the water
   5. Changing salinity of the water
   6. Lowering water oxygen content
   7. Poisoning with various poisons

C. Methods of scale removal
   1. Inhibited acids
   2. Bases
   3. Flexing of tubes
   4. Thermal shocking

Storing Tubes

Damage to tubes in storage is not uncommon. The following suggestions may help:

1. Keep tubes in cases, flat until ready for use—don't stack high enough to crush bottom cases.
2. Select a dry, protected storage location not subject to extremes of humidity and temperature.
3. Avoid outdoor storage especially where there is dirt, smoke, soot, and corrosive fumes.
4. If cases become watersoaked, both the cases and tubes should be promptly dried out.
5. When ready to use, remove tubes from cases carefully.
6. If stored in racks, tubes should be properly supported.

Checking Vibration

Excessive vibration of tubes can lead to corrosion fatigue cracking. In old heat exchangers vibration has been reduced by:

1. Using more tube support sheets.
2. Wedging pieces of wood or flattened tubing between the rows of tubes affected.
3. Making sure that all equipment is running smoothly and by avoiding critical operating speeds of turbines, pumps, etc.

Selection of Alloys

Bridgeport's corrosion laboratory can be very helpful in the selection of the alloy which will stand up best under present operating conditions. The importance of trying out samples of various condenser tube alloys under actual operating conditions cannot be overemphasized. Today's more severe operating conditions often call for better, more corrosion resisting alloys. For example, Admiralty must often be replaced by Aluminum Brass or Aluminum Bronze or Cupro Nickel in order to obtain satisfactory service life on the eastern seaboard. Call our nearest branch office for help.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • ESTABLISHED 1865

Mills at Bridgeport, Connecticut, and Indianapolis, Indiana • In Canada: Noranda Copper and Brass Limited, Montreal

(Advertisement)

REPUBLIC ELEVATOR BELTING Ended Costly BREAKDOWNS IN THIS QUARRY

Not one breakdown since Republic Elevator Belting was installed two years ago—that's the story at the T. B. Gatch & Son Quarry in Calvary, Maryland!

Their primary crusher spews out hundreds of tons of crushed rock daily, and every pound of it is carried off via elevator belting. When other ordinary belts proved inadequate, and a series of paralyzing breakdowns disrupted production schedules, Republic was called in to analyze the problem.

Republic's Baltimore Distributor, Robins Rubber Division of the A. K. Robins & Company, recommended Excelo Elevator Belt.

Today, after a grueling two-year run, the same belt is still giving uninterrupted service . . . going strong as ever!

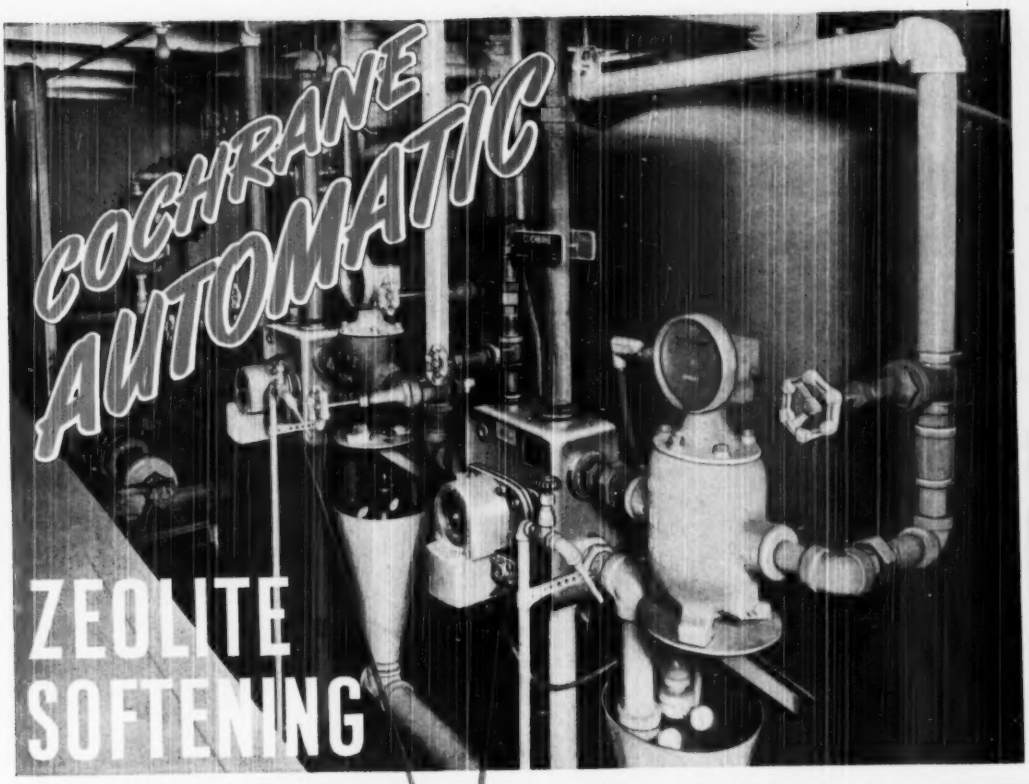
Matching the product to the job is a Republic policy that's paved the way for success stories like this in every industry. This service, meaning trouble-free operation, is available to you. So write us today about your toughest hose or belting problems. We'll introduce you to your local Republic Distributor . . . a man who has the answers! Remember, Republic Rubber has been *the* specialist in the industrial rubber goods field for more than 48 years.

Mr. H. E. Brodnax, Manager
Robins Rubber Division
A. K. Robins & Company, Inc.
Baltimore, Md.

Pioneers in the use of COLD RUBBER

REPUBLIC RUBBER DIVISION
LEE RUBBER & TIRE CORPORATION, YOUNGSTOWN, OHIO
Lee Deluxe Tires & Tubes - - - Conshohocken, Pa.

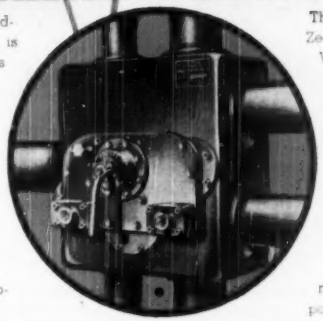
MECHANICAL RUBBER GOODS BY
REPUBLIC RUBBER DIVISION



with the COCHRANE HYDROMATIC VALVE

The new Cochrane Hydromatic Valve, standard equipment on Cochrane Zeolite Softeners, is readily adaptable to automatic control. This is a fact of prime importance to any user of zeolite softeners for, with the Hydromatic Valve, no change in the physical plant is necessary—merely the simple addition of a control box and a small drive motor.

Automatic operation of Zeolite Softeners makes possible economies in the amount and cost of the zeolite materials that often offset the cost of the control accessories, aside from the convenience of the automatic operation.



The points in favor of Cochrane Automatic Zeolite Softening System with the Hydromatic Valve are these:

1. Simplest and most positive single control valve ever built—six valves in one.
2. Automatic Control with the Hydromatic Valve means merely the addition of control box and a small 1/30 H.P. drive motor—no changes in the physical plant.
3. Cost of labor attendant on manual operation is eliminated.
4. No objection to shorter regeneration period permitting savings on amount and capacity of zeolite materials.

COCHRANE CORPORATION • 3106 N. 17th Street • PHILADELPHIA 32, PA.

In Canada: Canadian General Electric Company, Ltd., Toronto

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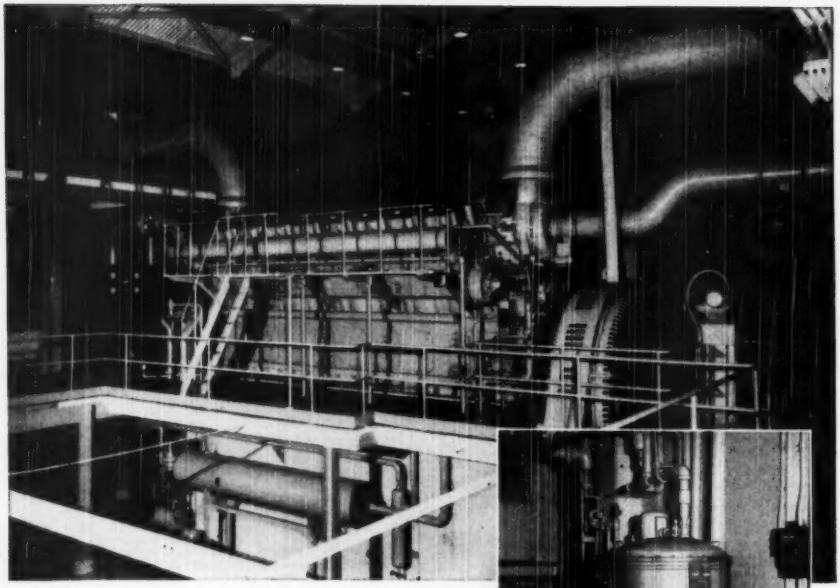
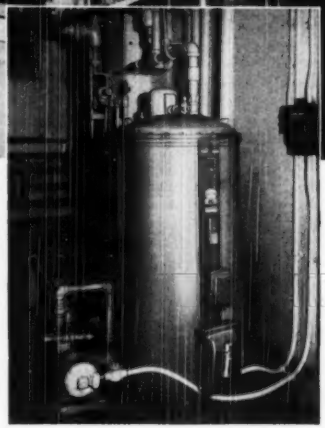




Cooper-Bessemer New Diesel Installation for Arizona Edison . . . is

WELL INSURED

with HONAN-CRANE OIL PURIFICATION

It is significant that the new *gas diesel* installation at Yuma, Arizona, includes Honan-Crane Oil Purification to assure maximum protection for engines operating round the clock at near peak capacity.

Time-tested engineering features have made Honan-Crane first choice for Diesel oil purification because Honan-Crane Purifiers not only remove all solid contamination, sludge and abrasive particles which endanger engine bearing surfaces . . . but also remove all products of oxidation . . . acids, asphaltenes, resins, etc., which may destroy bearing clearances or take corrosive action on the metal itself.

Honan-Crane Purifiers preserve all the desirable lubricating properties of the oil . . . assuring long, trouble-free Diesel performance . . . reducing to a minimum any danger of shut-down or repairs due to contaminated oil.

Like many other large utilities, Arizona Edison has invested in low-cost Diesel insurance . . . by selecting Honan-Crane oil purification to protect this fine new installation.

● **SHOWN ABOVE: 3300 HP, 16-cylinder Cooper-Bessemer gas diesel and 1650 HP 8-cylinder C-B gas diesel at Arizona Edison's new Yuma plant operate round the clock at close to rated capacity of 3375 KW. Lube oil for both engines is kept free of all contamination by Honan-Crane Purifier (inset).**

Write to Honan-Crane Corp., 200 Superior Avenue, Lebanon, Indiana, for complete information on Your Particular Oil Purification Problems.

HONAN-CRANE CORPORATION

A Subsidiary of

HOUDAILLE-HERSHEY CORPORATION

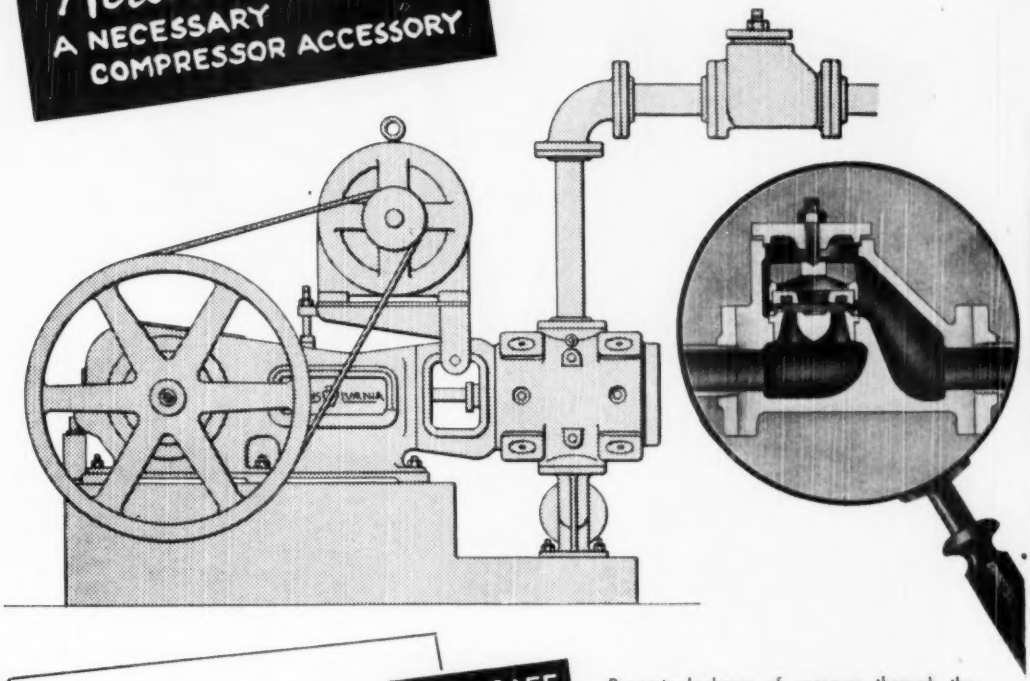
PENNSYLVANIA *Aircheck Valve*
A NECESSARY COMPRESSOR ACCESSORY

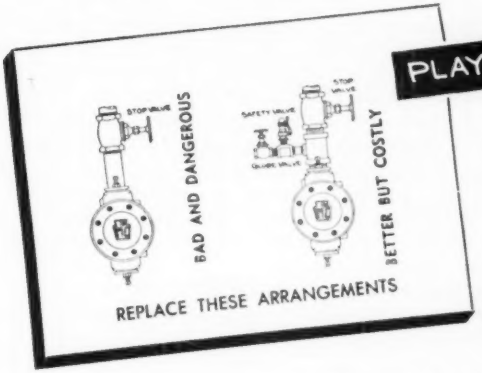
The Pennsylvania Aircheck Valve is an adaptation of the Company's well-known *Air Cushion* valve to function as an aircheck valve in the discharge line of an air or gas compressor.

Among the advantages provided by this aircheck valve are the following:

Automatically and positively eliminates all danger of damage through failure of operator to open a valve when starting the compressor.

Dispenses with the customary arrangement of stop and safety valve as shown.





Prevents leakage of pressure through the compressor during the "off" cycle.

Dampens pipe line pulsations.

Permits repairs without shutting down the system where more than one compressor is on the line.

Available in all sizes for either flanged or screwed connection, high and low pressure.

Suitable for both compressed air and gases.

Please ask for descriptive Bulletin No. 509

PENNSYLVANIA PUMP and COMPRESSOR COMPANY

BUSHKILL DRIVE **EASTON, PA.**

PFI STANDARDS for Better Piping Include Piping Requirements of these codes

"STANDARDIZATION Assures Quality and Promotes Economy"

The standards for uniform pipe fabricating practices being published by the PFI take into account the requirements of the above Codes in-so-far as they apply to piping. Pipe fabrication in accordance with PFI Standards will comply with these Codes.

In the PFI Standards, these Codes are interpreted correctly by engineers of long experience in piping. Economic factors are given equal consideration with technical and manufacturing questions.

PFI Standards, used by all qualified pipe fabricators, assure the customer of better piping and maximum dollar value. The designing engineer will find that they save time for him . . . also save time in materials procurement and in erection.

If you are interested in having (without charge) the four PFI Standards already published and receiving the additional Standards as they are issued, address your request to—

THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

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It looks simple..

. . . it's a precision device. A BS&B SAFETY HEAD is a preformed metal rupture disc held together by two specially designed flanges. When over-pressure threatens, this "weak spot" bursts and saves the vessel. It looks simple . . . but each part is made with extreme care and precision.

Behind the delivery of SAFETY HEADS to you for the protection of your equipment and employees are 4 big factors:

1 "KNOW-HOW" gained by priceless years of experience in this highly specialized field. 2 A STOCK-PILE . . . an amazingly large stock-pile of many metals with countless sizes and thicknesses—all of controlled specifications and uniformity. 3 SPECIAL EQUIPMENT painstakingly designed and built by BS&B for the one job of building SAFETY HEADS. 4 A LABORATORY . . . completely equipped to test the qualities and properties of metals used in SAFETY HEADS.

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BS&B SAFETY HEADS

Just mail the coupon now for complete information on these amazing safety devices. We'll be glad to send you all the facts . . . specifications . . . prices. Do it now!

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Yes, I am interested in BS&B SAFETY HEADS.

☐ **Please send me complete information.**

☐ **Please arrange for a Sales Engineer to call on me.**

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We're not out to corner the DAMPER MARKET...

. . . we want HEACON DAMPER applications that will pay for themselves in 6 months.

The Heacon Damper is not just *another* damper. It is designed and engineered to provide the tightest closure possible under all conditions. Each damper is developed to solve a specific problem, each provides the ultimate in control.

The dampers shown on this page all solved specific problems that could have been solved in no other way.

As an example, the second damper from the left above, not only controls 80" w.g. pressure, but also acts as an automatic reverse flow valve that instantly closes and prevents leakage should one of two fans on the boiler fail. The next damper on the right isolates its air heater for maintenance while the boiler continues in service. Such applications save many times their cost, in time and power loss.

Call or write the office nearest you for full details.

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BURGESS-MANNING SNUBBERS

In every field of industrial activity . . . utility, manufacturing, petroleum . . . where noise from engines or compressors, gas surging in pipe lines, or harmful engine or compressor vibration cannot be tolerated, you will find Burgess-Manning Snubbers. Snubbers prevent noise by smoothing the flow of intake air and dissipating the energy in the exhaust gas slugs, providing quiet operation without affecting performance. Consult the Burgess-Manning engineers for a solution to your noise problems.

BURGESS-MANNING COMPANY
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SDG Slug Buster Snubber

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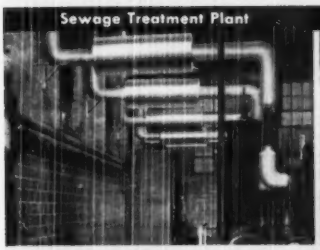
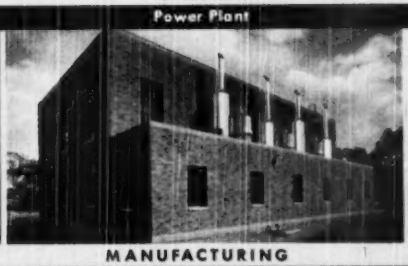
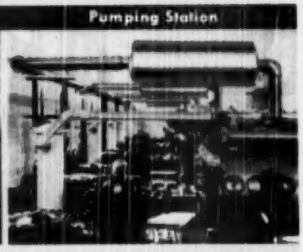
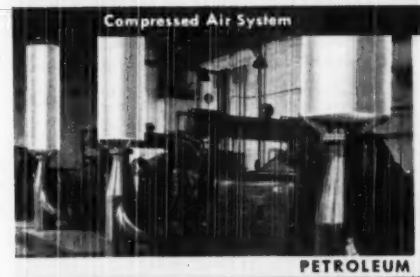


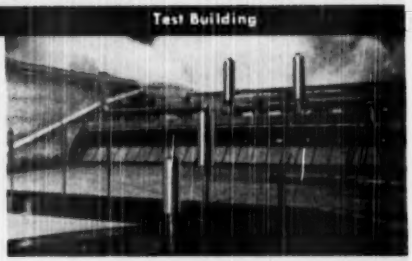




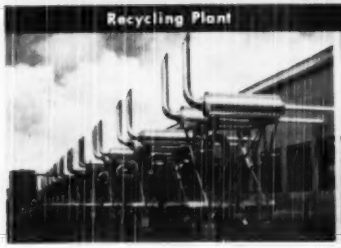
MANUFACTURING



SNUB THE SLUG AND STOP THE NOISE



PETROLEUM



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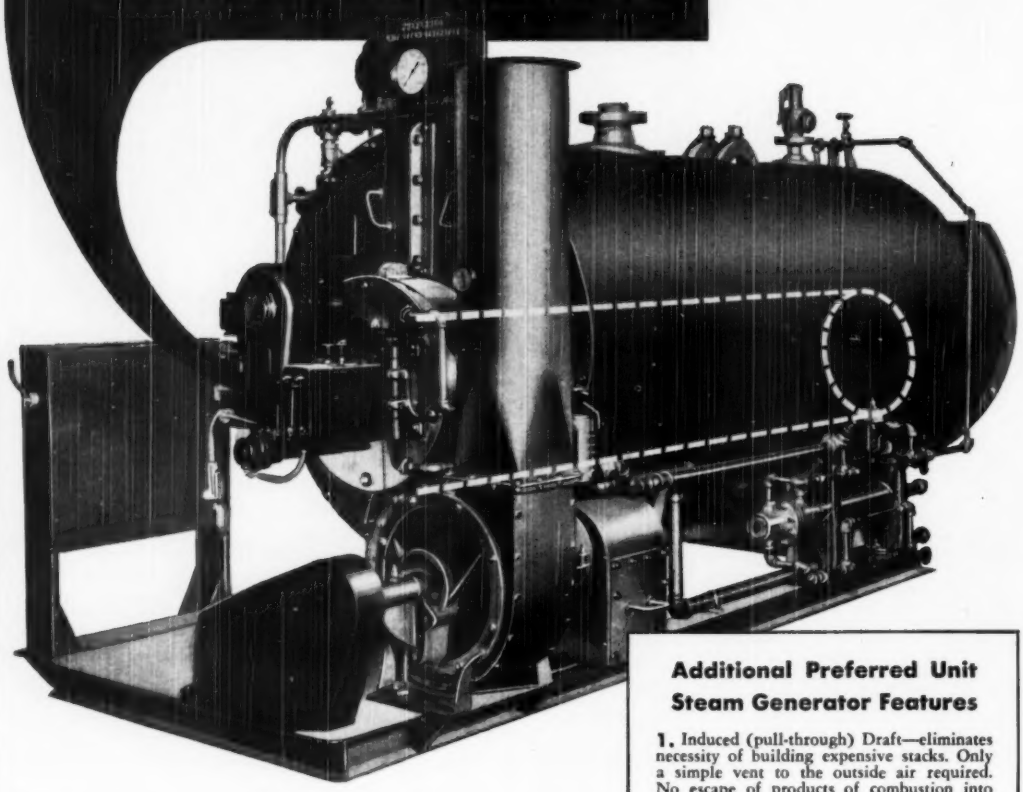

Furnace relatively low in the drum saves you trouble because this location gives extra protection against damage due to low water—allows lower shell water level—and lessens liability of corrosion.

In addition to this "low-furnace" feature, the Preferred unit has both float and electrode type of low water cutoffs, thus affording triple protection against low water. As a result of this triple protection, no case has been reported of a Preferred furnace burning out. Because the furnace is below the point at which most of the steam bubbles form, it is in contact with water all the time . . . there's less possibility of corrosion from oxygen.

Shell water level is low, giving more steam releasing area. Additional steam dome capacity is gained. Foaming and water carry-over are minimized. Delivery of dry steam is assured.

These features are examples of the careful planning Preferred combustion engineers have put into the design of the Preferred Unit Steam Generator. They are examples also of the benefits you will get when you replace your present boiler with a modern Preferred Unit. Write today for complete information.

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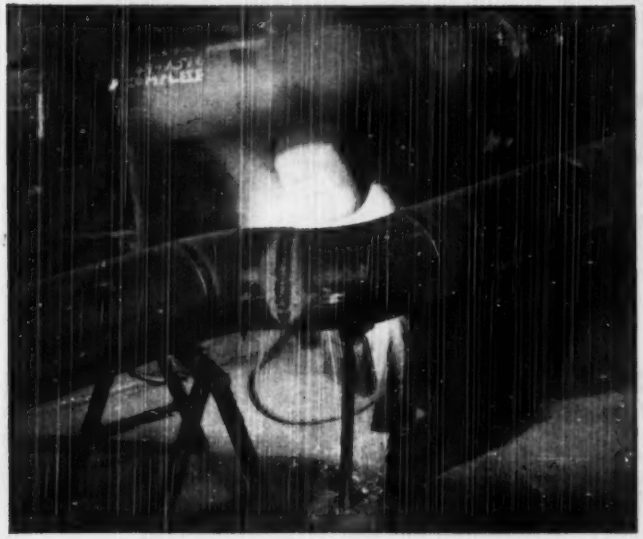
how to GET MORE WELDING from your PIPE WELDERS



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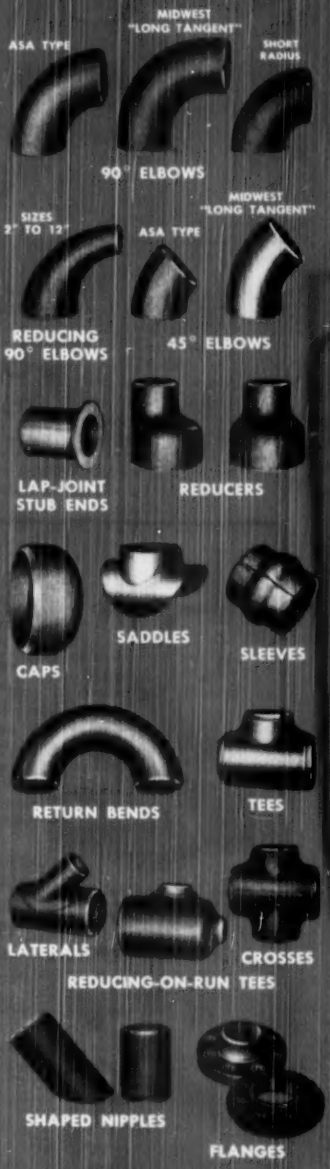

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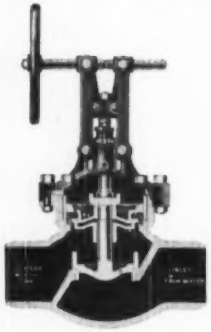
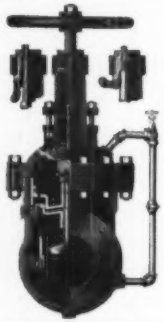


G-A Single Acting Non-Return Valve, Toggle Yoke Design, Globe Pattern



G-A Combined Throttle and Automatic Engine Stop Valve, Globe Pattern

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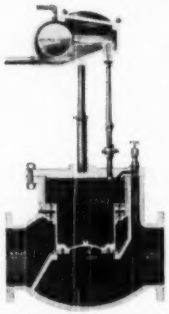
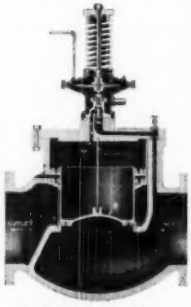


G-A High Pressure Controlling Float Valve, Globe Pattern



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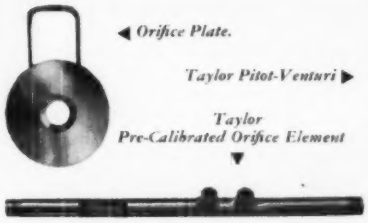

◀ *Orifice Plate.*

Taylor Pitot-Venturi ▶

Taylor Pre-Calibrated Orifice Element ▼

(1) Thin and thick type Orifice Plates from 2 to 24" in all standard materials. (2) Pre-Calibrated Orifice Assembly for high-accuracy with pipe sizes less than 2" are a "Specialty of the House" with Taylor. (3) The new and exclusive Taylor Pitot-Venturi Flow Element which produces greater differential with practically no pressure loss—7 to 10 times greater than by the conventional Pitot Tube. (4) Also standard Venturi Tubes. (5) Flow Nozzles from 3 to 14" in all standard materials.

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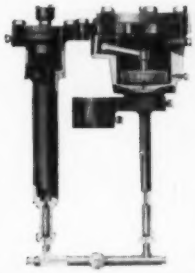
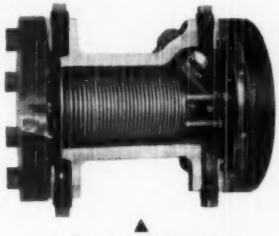


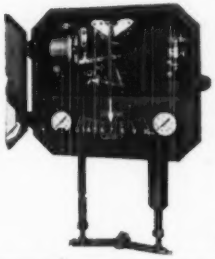


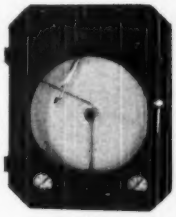
▲ *Taylor Aneroid Manometer*

◀ *New Taylor Mercury Manometer*

(1) New Taylor high-accuracy Mercury Manometer which features Teflon bearings, high energy output, submerged check valves, ½ of 1% accuracy, an adjustable leakless damping unit, and interchangeable range tubes for continuous ranges from 10 to 533 inches of water. (2) Taylor Aneroid (Mercury-less) Manometer, available in All-316 Stainless Steel or Cast Steel, accurately measures flow of hard-to-handle corrosive materials. No mercury to replace, no stuffing box. Sealing fluids or blow-back systems seldom needed. Long service. Easy cleaning. Easy range changes. Both Manometers available with Square Root Integrators.

• FOR TRANSMISSION





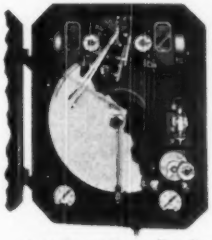
▲ *Fulscope* Recording Receiver Controller*

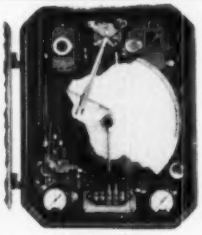
◀ *Taylor Indicating Transmitter*

Taylor Remote Transmission Systems accurately, quickly, economically, and safely transmit rate of flow to conveniently located point. Transmitters can be indicators, recorders or controllers. High accuracy—systems are calibrated to within ½ of 1% accuracy. High speed—only 2-second lag in 300 feet. Gives central control of widely distributed processes at one convenient point. Concentric dial transmitter with Mercury Manometer also available.

*Trade-Mark

• FOR CONTROL





▲ *Controller with internally mounted automatic-manual unit*

▲ *Fulscope Recording Pneumatic-Set Flow Controller*

Indicating or recording controllers in single or double duty form, with adjustable sensitivity or automatic reset. Ratio Flow Controllers with two Manometers attached. Control point may be adjusted by any other process variable. Pneumatic-set controllers whereby control point can be pneumatically adjusted from any remote location. Internally or externally mounted automatic to manual units.

• • •

For complete details, write for new Flow Catalog 98175, or ask your Taylor Field Engineer. He'll show you how Taylor Instrumentation can help you solve *any* flow problem. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

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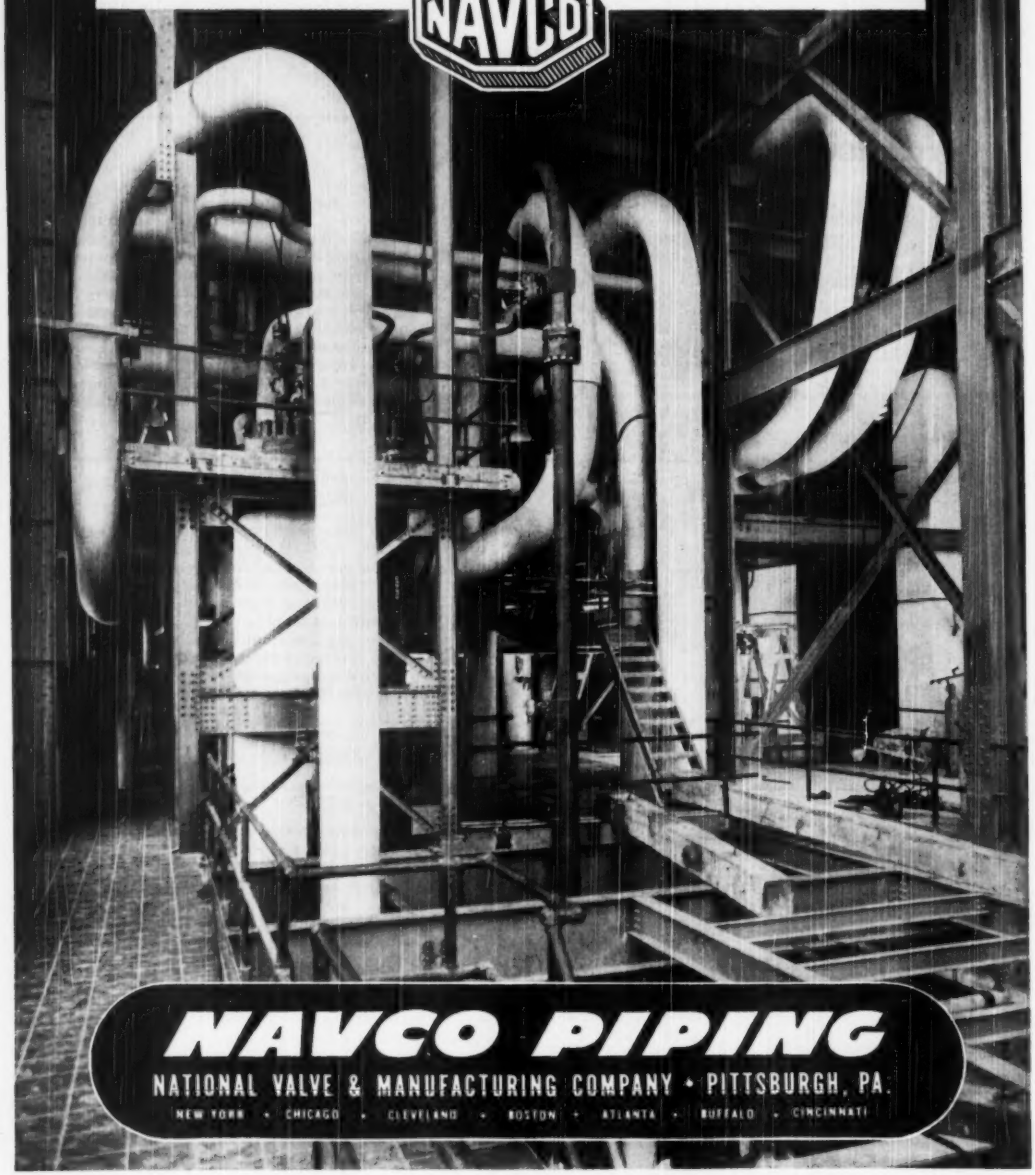

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FISHER TYPE 510-S

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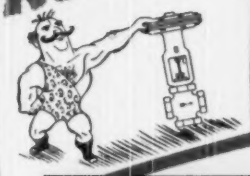
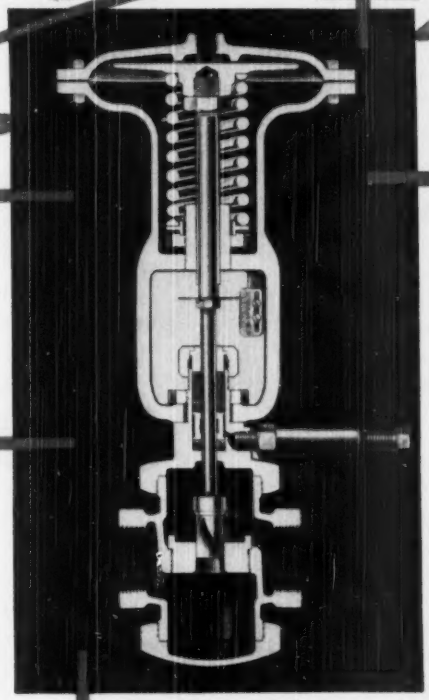


PRESSURE REGULATOR and DIAPHRAGM CONTROL VALVE



MATERIAL

Bronze and stainless steel bodies.

SIZES

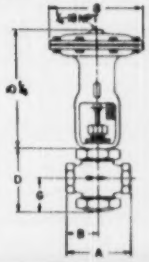
½" to 2."

SERVICE

For direct action pressure regulators and reducing valves up to 50 pounds reduced pressure.

For 2 to 15 pounds pneumatic actuation with ¾" valve travel and utilizing popular Micro-Flute Pup inner valve, V-Port, Quick-Opening or Composition Disc inner valve in single seat valves—or available with double ported V-Port or Quick-Opening inner valve construction.

Particularly adapted to service where small size and compactness are desirable.



DIMENSIONS

SIZE	A	B	D	G
½	3⅜	1 15/16	3 15/16	1 15/16
¾	3⅝	1 15/16	3 15/16	1 15/16
1	4⅛	2 1/16	4⅝	2⅜
1¼	4⅛	2 1/16	5	2½
1½	4⅛	2¾	5½	2⅞
2	5¼	2⅞	6½	3 3/16

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GET IMMEDIATE AND PERMANENT RESULTS WITH

CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS

AS A SOURCE OF IMPORTANT SAVINGS

Today cost pressure keeps demanding new ways to save money. You can get at the root of this situation in your boiler room.

Whether you have one or a battery of boilers you'll find your boiler room can deliver good savings through Correct Fuel Feed — Fuel-Air Ratio, and Over-Fire Draft.

You accomplish this with CASH STANDARD Automatic Combustion Control Systems. What you actually get is more steam from your present boiler—less fuel, coal-oil-gas used—savings in maintenance. CASH STANDARD units are available in a number of variations. Combinations can be made to give you complete automatic control with all of its benefits. Size of your boiler or type make no difference.

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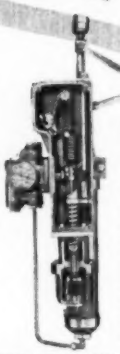
BULLETIN 300

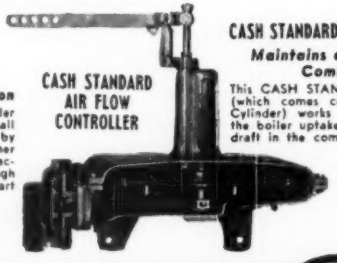
It shows applications—tells how the system works—gives you a good insight into the savings possible.



CASH STANDARD FUEL FEED CONTROLLER . . .

Automatically Regulates Fuel Feed

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion — hence, money saving.



CASH STANDARD AIR FLOW CONTROLLER

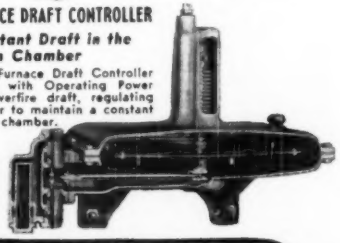
Meters the Air Needed for Combustion

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.

CASH STANDARD FURNACE DRAFT CONTROLLER

Maintains a Constant Draft in the Combustion Chamber

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.



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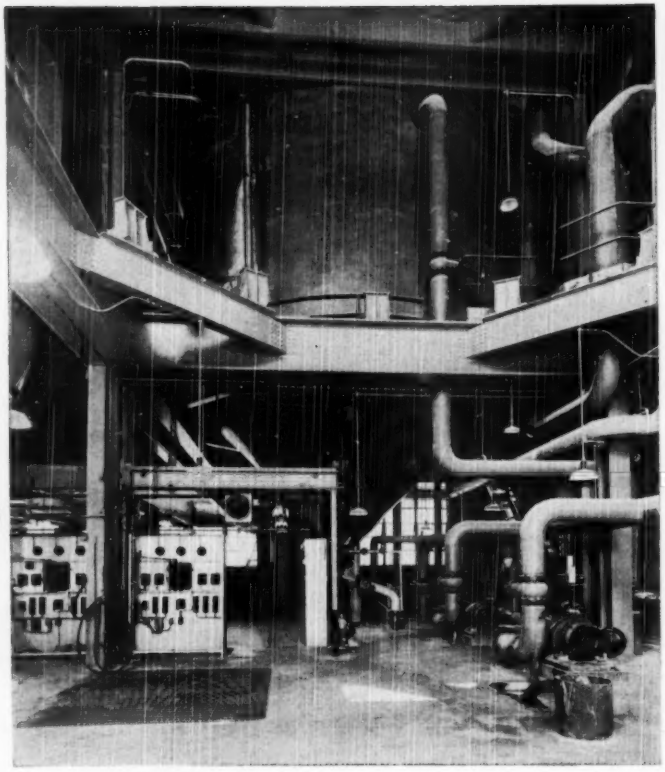
One of the two 85,000 gph GRAVER Hot Process Softeners installed at Indianapolis Power & Light Co. The photograph shows the lower portion of the sedimentation tank inside the building.



"Success Story" of GRAVER

Hot Process Water Softeners

This GRAVER "Success Story" took place at the Indianapolis Power & Light Co. Five Hot Process Softeners of another make were being used, but a more efficient central installation was desired. A single GRAVER unit was installed to replace the five existing older units. When the plant was later expanded, an additional GRAVER Softener was installed. These two GRAVER Hot Process Lime Soda Softeners have a combined capacity of 170,000 gph, and are treating feed water for boilers operating at 625 psig and 750°F.

The thorough effectiveness of this GRAVER installation is shown in the following results: The raw water hardness of 290 ppm is reduced to less than 15 ppm with excess soda ash of 25 ppm and causticity of approximately 10 ppm (all as $CaCO_3$). An effluent turbidity of less than 8 ppm results in minimum filter back-washing.

And here's another GRAVER advantage to remember. All major component parts of the Softeners were fabricated in the GRAVER shops, and the units were erected and initially operated by GRAVER, providing a single responsibility for the entire job.

A new GRAVER bulletin explaining the functions, principles and applications of Hot Process Softeners and the distinctive features of GRAVER designs is now available. You will find it particularly informative and helpful. Write for your copy today.

GW 408

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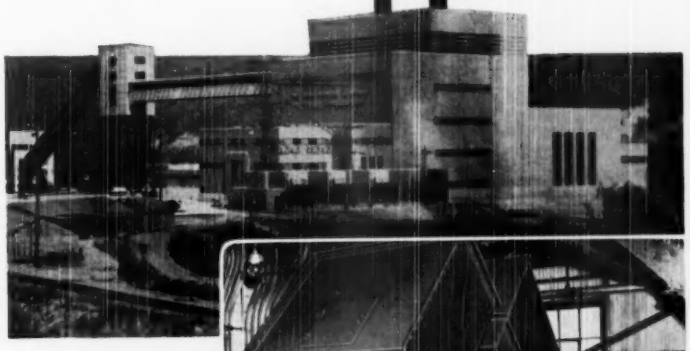
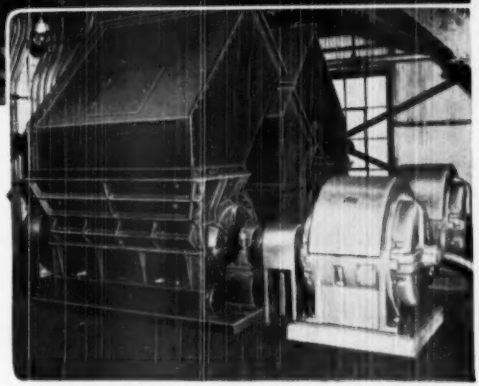
. . . a complete operation in less space than 12' x 12' x 12'



Ohio Power Company
Tidd Plant at Brilliant, Ohio



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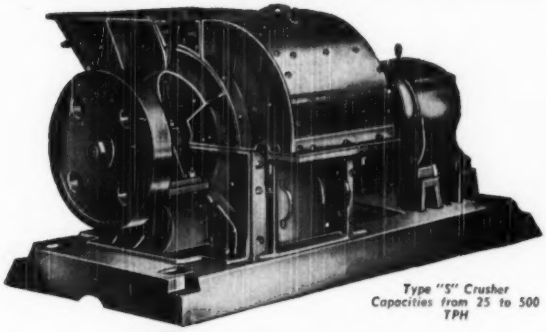

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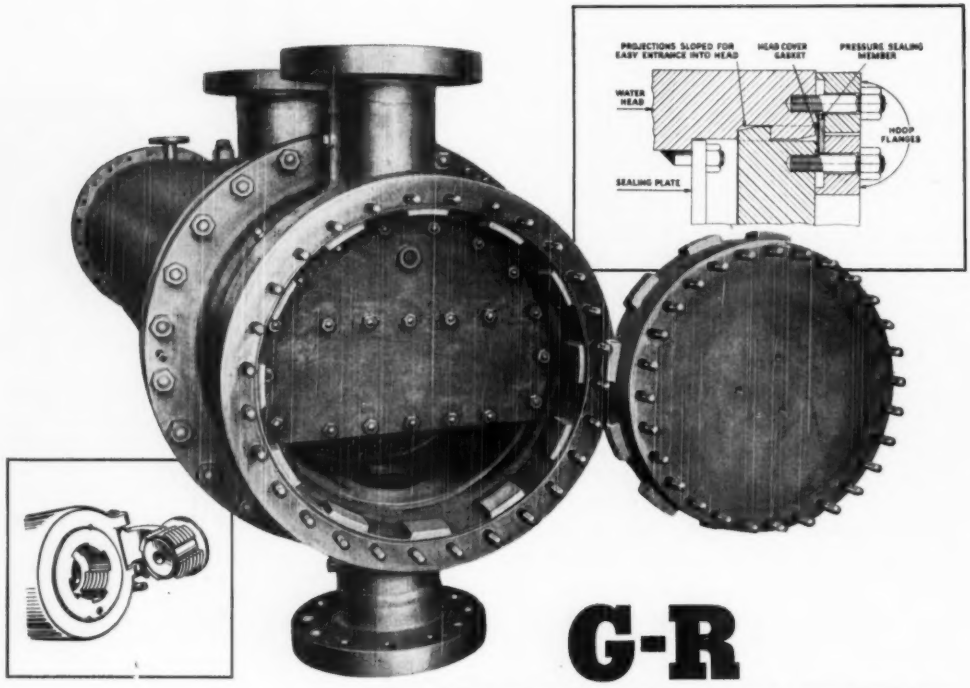

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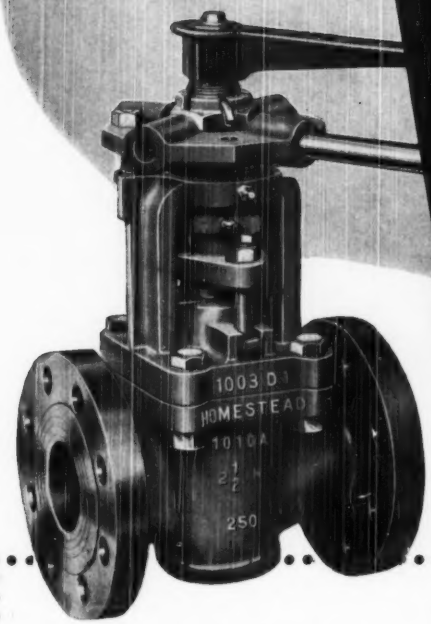

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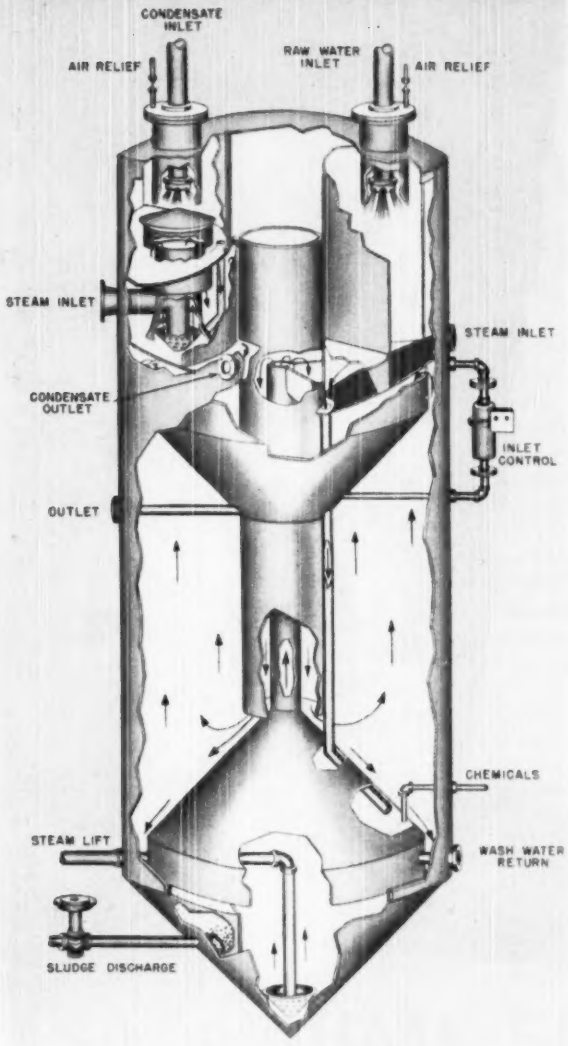

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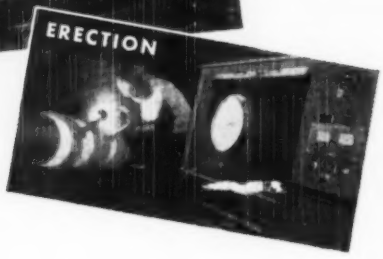

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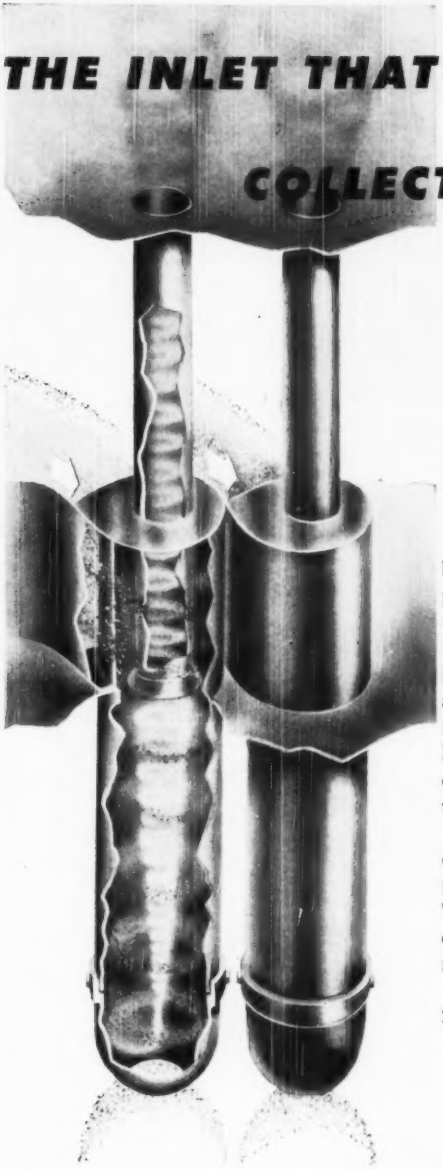

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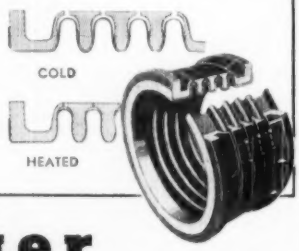

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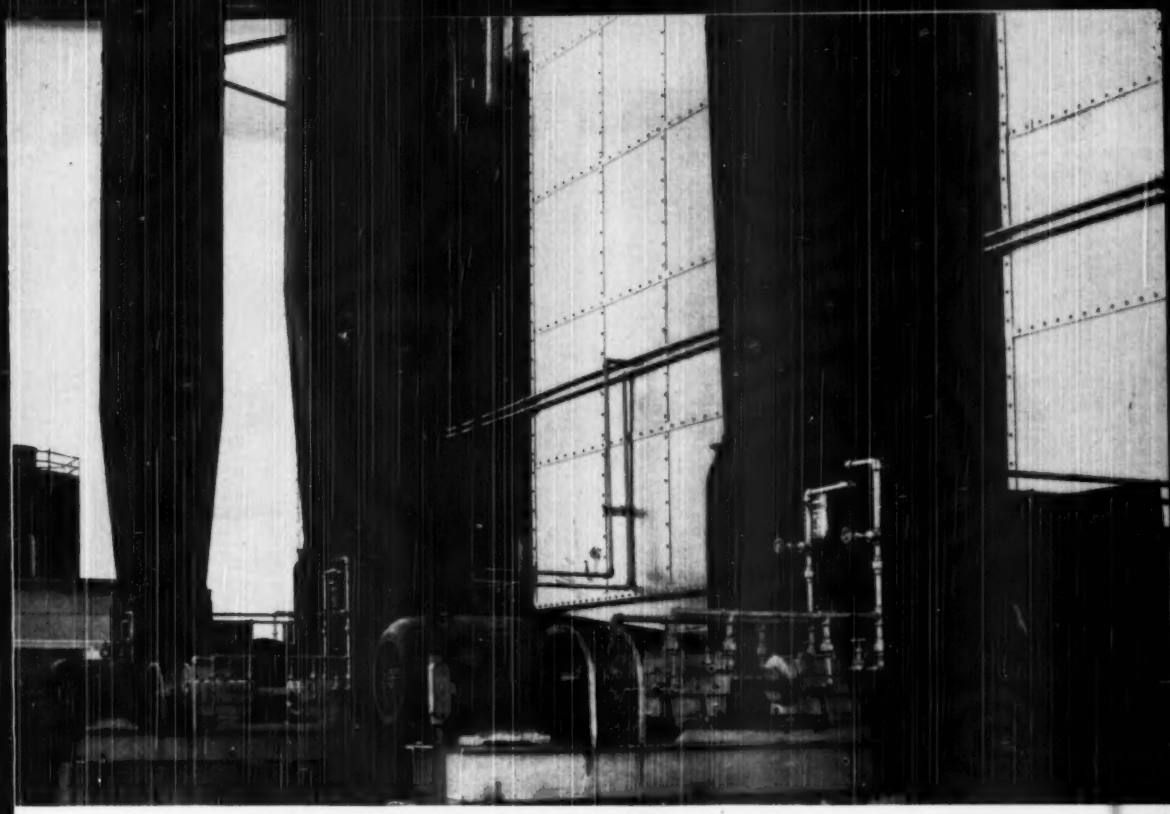

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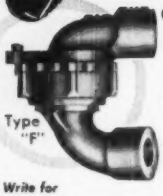

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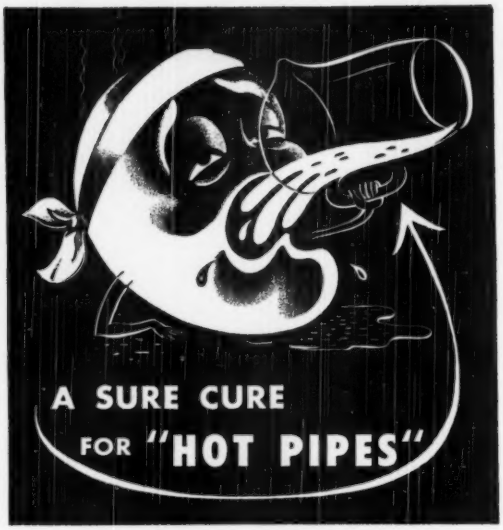

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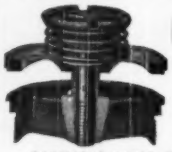

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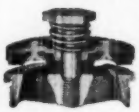

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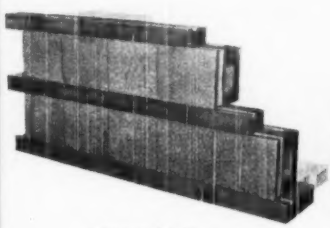
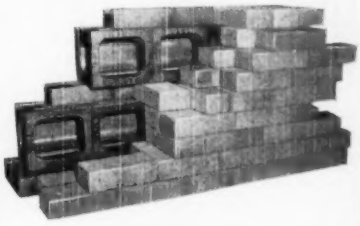
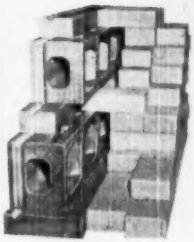


Crystolon Blocks
and Special 9" Brick Fire Face View



Rear View
Showing Hollow Block Design



End View
Showing Air Passage

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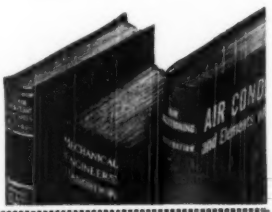

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SQUIRREL CAGE MOTORS

HP	RPM	Volts	Make
750	900	6600	Westgh
350	3550	2200	Westgh-CS
300	1800	440	Al-Ch
300	900	440	GE-I-17
300	514	440	GE-I
250	1200	440	GE-KTR
250	600	2300	Triumph
225	514	440	GE-I-14
200	495	2200	GE
200	600	440	Westgh-CS
150	600	2200	GE
125	3600	220/440	Al-Ch AN
125	1200	440	Century
125	340	220	A-C
100	1200	2200	Al-Ch AR
75	3600	2300	GE
75	1200	220/440	GE-K505Y
75	900	2300	GE
60	3600	2300	GE-KT
60	1800	440	Lincoln
60	1800	2300	GE-FTR
50	3600	440	R & M
50	1800	220	Triumph
50	1200	220/440	GE-Tri-Glad
50	900	220	GE
50	720	2300	Wtg-CS
40	1200	550	A-C AN
40	900	2300	Wtg-CS
40	900	220	Lincoln
40	720	440	GF-RT
35	1800	220	GE type I
35	600	440	GE type I Form M
30	1200	dual	Master
30	900	220	Lincoln
30	900	220	Wagner (Hi-Torque)
30	720	220	GE-HJ
30	514	440	Stanley
25	3600	dual	L-A
25	1800	220	L-A, BD
25	1200	220	Wesche
25	1160	208/416	Wtg-CS
25	900	440	GE
25	690	220	Westgh, type CS
25	575	220	GE-type M
20	3500	440	Al-Ch

ENCLOSED SQUIRREL CAGE

HP	RPM	Volts	Make
125*	1200	440	GE-TE-FC-BB
75	1200	2200	GE-TE-FC-BB
60	900	440	GE-TE-FC-BB
30	900	440	Reliance, TE-FC-BB
20	3600	dual	Delco-TE-FC-BB
20	1200	440	Wagner
20	900	440	GE-TE-FC-BB
15	1200	220/440	Delco-TE-FC-BB
15	900	440	GE-TE-FC-BB
10	3600	220/440	F-M
10	1200	440	GE-TE-FC-BB
7½*	1800	dual	Wagner-TE-FC-BB
7½*	1800	dual	Master-TE-FC-BB
7½	1200	dual	GE-HI Slip-TE-BB
7½	1200	dual	Delco
7½	1090	220/440	GE-HI Slip
7½	900	dual	Delco-TE-FC-BB
5	3600	dual	Delco-TE-FC-BB
5*	1800	dual	Master-TEI-C-BB
5	1800	220	Wagner-TE-B-BB
5*	1200	dual	GE-TE-FC-BB
5	3600	dual	Delco-TE-FC-BB
5	1800	dual	Delco-TE-FC-BB
3	1800	440	GE-TE-FC-BB
3	1800	dual	Delco
3	1800	dual	Delco-TE-FC-BB

*New Motor

ENCLOSED SQUIRREL CAGE Cont'd.

HP	RPM	Volts	Make
2	1200	220	GE-TE-BB
2	900	220	Wagner-TE-BB
1½	1800	dual	L Al-TE-BB
1½	1200	dual	Delco-TE-FC-BB
1½	900	dual	Delco-TE-FC-BB
1	3600	220	Haakins-TE-FC
1	1800	dual	Master-TE-FC-BB
1*	1800	dual	Delco-TE-BB
1	1200	220	GE-KT
¾	3500	440	Delco-TE
¾	1800	dual	Wesche-TE-BB
¾	900	dual	Delco-TE-FC-BB
½	1800	440	Delco-TE-BB
½	1800	dual	Delco-TE-BB

SLIP RING MOTORS

HP	RPM	Volts	Make
500	900	440	GE-3 Brg
400	1200	2300	Al Ch
375	1800	2300	Al Ch
250	900	2200	Westgh
300	720	2300	Al Ch
250	720	440	GE-MT
250	300	2300	Al Ch
225	1800	220	GE-I
200	1800	440	Al Ch
150	1740	440	GE-MT
75	1800	220	GE
75	900	440	Al Ch, ANY
75	720	2300	Wagner type BB
60	1800	dual	Al Ch
60	900	2200	Burke
60	900	220	Wesche
50	1800	220	GE-MT
50	900	2300	Ridgeway
50	900	440	Wagner
50	720	440	Al Ch
40	1200	220	GE-MT-336
40	900	220	A-C
40	720	2300	Wtg-HF
40	720	220	Al Ch-ARY
40	600	2300	Al Ch-ARY
40	600	220	Al Ch-ARY
40	450	220	Triumph-C
35	900	2200	GE
35	900	220	Al Ch
35	900	2300	Ridgeway
35	720	220	GE
35	570	440	GE-I
30	1800	2300	Wtg-CW
30	1800	2300	GE
30	1200	440	Wagner
30	1200	220	GE-MT
30	600	220	F Morse-BV

VERTICAL MOTORS

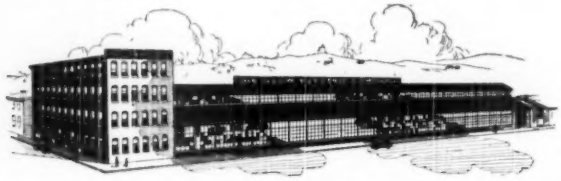
HP	RPM	Volts	Make
200	1200	440	Al Ch-8R
150	1200	2200	GE-I-8R
150	1200	440	GE-Cage
125	1200	2300	Al Ch-8R
125	1200	2300	Al Ch-Cage
100	1200	440	GE-Cage
75	1200	2200	GE-Cage
75	300	220	Ideal-Cage
60	1800	220 DC	GE
60*	1200	440	Al Ch-C

VERTICAL MOTORS—Cont'd.

HP	RPM	Volts	Make
50	1200	2200	Wtg-Cage
50	600	440	Al Ch-Cage
40	1800	220	GE-Cage
40	1700	220 DC	GE
40	1200	440	GE-8R
40	1200	2200	Westgh-BB-Cage
35	1200	2300	Al Ch-Cage
35	450	440	GE-Cage
30	1200	dual	Wtg-Cage
28*	1550	220 DC	GE
25	1200	2200	GE-Cage
25	850	220 DC	Wtg
20*	1200	440	Al Ch-Cage
20	800	220 DC	GE-RC
15*	1800	440	Al Ch-Cage
15	1750	110 DC	Wtg
15	1150	220 DC	GE
15	600	440	Al Ch
12½	900	220	L Al-Cage
10	3400	220 DC	Wtg
7½	1800	500 DC	Peerless
7½	900	440	Burke
7½	700	220 DC	GE
6	850	110 DC	Rel
5	1400	115 DC	R & M
5	600	440	GE-Cage
4	1650	110 DC	Watson
3	3000	dual	Delco
3	1700	230 DC	Watson
3	1200	dual	Wtg-Cage

SYNCHRONOUS MOTORS

HP	RPM	Volts	Make
3000	720	4800	GE-ATI
1015	500	2200	Wtg-25 cycle
710	720	13200/6800	GE
500	514	440	GE
435	720	2300	GE type ATI
320	900	2300	GE-ATI
250	1800	2300/4160	GE-ATI
250	225	2200	GE-TS
225	900	4100	GE-ATI
220	600	2300	GE-ATI
175	235	220	GE-TS (rotor & stator only)
160	600	440	GE-ATI
160	184	480	GE-TRF (rotor & stator only)
150	1800	2200	GE
150	1800	220	GE-ATI, single bearing
150	900	440	Star
150	720	440	Westgh
130	225	220	E-M, rotor & stator only
115	164	208	GE
100	1200	220	Wstg single bearing
95	1200	220	Burke
75	1200	220	Westgh
75	900	2300	GE-ATI-7552
60	360	2200	GE, rotor & stator
50	1200	440	Wagner
50	900	220/440	Westgh
50	720	440	GE-TS
50	360	440	GE, rotor & stator
50	300	220/440	Wtg, (rotor & stator only)
30	900	440	Wagner
30	600	550	GE, rotor & stator
30	450	dual	Wtg, rotor & stator
30	360	550	GE
30	327	220	E-M, rotor & stator
25	1800	220	Wagner
25	450	220	E-M, rotor & stator
20	1200	440	Wagner
20	900	220	Wtg
20	600	220	E-M, rotor & stator



D. C. MOTORS

115 Volts

HP	RPM	Description
225	750	GE-MPC
50	120	Al Ch
35	975	Northern
30	1800	F-M
30	200/600	Sprague
25	1150	Triumph
25	750	GE-A
20	700	Triumph
20	500/1500	GE-RF11
20	400/1200	GE-RLC fr 202A
18	1600	Sturtevant MPS
15	1200	J & L
15	1000	GE-CE
15	975	F-M
15	725	Westgh-8 fr 6
12	1075	J & L
12	580	Westgh-8K-113
10	3450	Imperial
10	1700	Fairbanks-Morse
10	650	J & L, type CI
10	400/1600	Watson-BW15B

GEAR HEAD MOTORS

60 Cycle, A.C.

Output HP	Output RPM	Volts	Ph	Description
20/10	375/185	440	3	Master-Two speed motor
10	450	220/440	3	Master-Vertical
5	6850	220/440	3	Master-Parallel
2	200/1800	220/440	3	Delco-Variable Speed Transmission
3	300	220	3	GE-Parallel
2	215/1500	3	3	Master-Vari-Drive
2	215	220/440	3	Master, Parallel
2	261	220/440	3	Master, Parallel
1½	5.4	220	3	Janette, Rt Angle
1½	358	110/220	1	Master, Parallel
1	420	220/440	3	Master, Parallel
1	2.2 to 11	220/440	3	U.S. Varidrive
1	190	115/230	1	Master, Parallel shaft
½	143	220	3	Master, Rt Angle
½	190	220/440	3	Master-Parallel Shaft
½	99	220/440	3	GE-Rt Angle
½	289	440	3	Janette-Parallel Shaft
¼	144	230	1	Master, Type RA
1/8	19	220/440	3	Master, PA-TE-BB
1/12	172.5	115	1	Wstgh Rt Angle

D. C. GENERATORS

125 Volts

KW	RPM	Description
1/40	1000/1300	Westgh, single bearing
500	750	GE-MCF
300	1500	GE-CC
200	900	GE-MPC
200	800	GE-DMC
100	1000	WE-DLC
100	900	Westgh-8K single bearing
55	1000	GE-Type TD
40	600	J & L-F Fed Type
35	1165	GE-DLC
31.25	1400	Westgh-8K single bearing

D. C. GENERATORS

230 Volts

KW	RPM	Description
400	1200	Westgh, single bearing
200	1200	GE-MPC single bearing
175	450	Westgh
50	1200	Al Ch-E-127
35	1800	GE-RC
30	300	Triumph
22½	765	Westgh-8K
20	1750	Delco Ballbearing
18	300	Burke
15	350	Westgh-8K

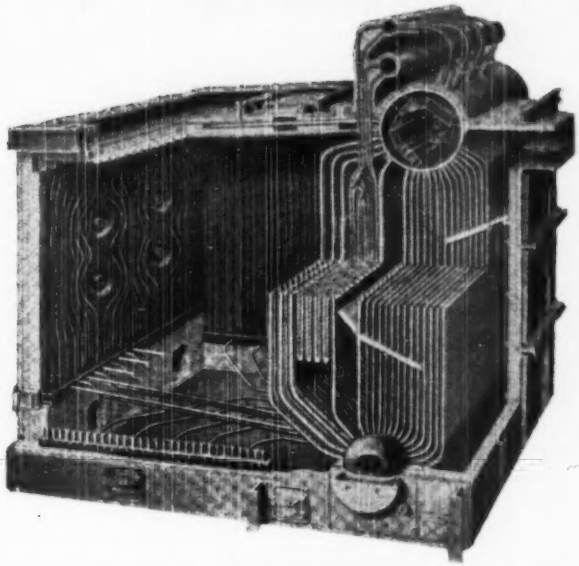
AC & DC MOTORS • GENERATORS • PUMPS
SYNCHRONOUS MOTORS • CONTROL EQUIPMENT
MOTOR GENERATOR SETS • ELECTRIC EQUIPMENT
STEAM ENGINE GEN. SETS • SLIP RING MOTORS

927 HARRIET ST.
PHONE MA. 3024
CINCINNATI 3, OHIO

BOILER SPECIAL NEW NEVER ERECTED

Induction & Forced Draft Fans

Heating Surface 7648 sq. ft. 648—2½" Tubes 18 ft.



FUEL: Oil, Coal, Gas, Pulverized Fuel

THE ABOVE NEW VU. TYPE COMBUSTION ENGINEERING 600#-psig., 750° FTT. 140,000-lbs. Steam per hr., ASME. CODE BOILER IS OFFERED FOR IMMEDIATE DELIVERY AT 40% BELOW TODAY'S PRICE FOR THE SAME BOILER. NEVER ERECTED. IMMEDIATE DELIVERY FROM STOCK.

ALSO 2 NEW, Never Erected G.E., 600#, 750 FTT. 5714-KVA., Turbine-Generators and 1—12,500 KVA., General Electric Turbo-Generator, same steam conditions at Very Substantial Savings.

ADDITIONAL BOILERS IN OUR STOCK: IMMEDIATE DELIVERY

2—4000-H.P., B&W bent tube, 300#, 470-FTT., Oil, Complete with all trim.

4—B&W, 450-psig., 740 FTT., 150,000# steam per hr., Oil, Complete.

2—3000-HP., 300-psig., 470 FTT., Bent Tube, 105,000# steam per hr. Multidrum type, Complete with all trim.

1—Combustion Engrg. Co., 4-drum, ASME. Code, 250# psi., 100° FSH., new 1934.

Traveling Crate Stoker: Good Condition.
Many Others. Write Us.

TURBO-GENERATORS: 6250-KVA., 2500-KW., 1500-KW., General Electrics 2500-KW., Westinghouse, and any capacity wanted, Condensing and Non-Condensing.

DIESEL-POWER: 1600-KW., F. M. Diesel Engine-Generator Sets, 500, 600, 750-KVA., G. M. Units, and anything wanted.

Send us your specifications covering your requirements

OUR BEAUTIFULLY ILLUSTRATED BULLETINS ARE WORTH FILING: 320 covers Diesels, 350—Boilers, 425—General List.

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WOODWARD 1-1341
WOODWARD 1-6038

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Quality and Service

"CERTIFIED REBUILT"

DEPENDABLE ELECTRICAL EQUIPMENT AT LOW COST

MOTORS . . . GENERATORS . . . M-G SETS

PUMPS . . . FANS . . . BLOWERS . . . SPEED REDUCERS

PARTIAL STOCK LISTING—WRITE, WIRE OR PHONE YOUR REQUIREMENTS

M-G SETS

KW	Mfr.	Input V	Output V
500	Whse.	2300 AC	250 DC
300	Allis Ch.	220/440 AC	250 DC
200	Gen.Elec. b.b.	220/440 AC	250 DC
200	Ridgeway*	2300/4000 AC	550 DC
200	Gen.Elec.*	220/440 AC	125 DC
200	Reliance*	220/440 AC	250 DC
150	Gen.Elec.	220/440 AC	125/250 DC
150	Burke*	230/440 AC	250 AC
150	Gen.Elec.*	2200/4000 AC	250 DC
105	Century b.b.	220/440 AC	70 DC
100	Allis Ch.	220/440 AC	125/250 DC
100	Allis Ch.	2300 AC	250 DC
100	Gen.Elec.*	220/440 AC	125 DC
75	Cr.Wh. b.b.(2)	220/440 AC	250 DC
75	Star*b.b. NEW	220/440 AC	250 DC
50	Whse.	230/440 AC	250 DC
50	Gen.Elec.(2)	220/440 AC	125 DC
40	Northw'n Conv.	220 AC	230 DC
35	Gen.Elec.	220/440 AC	48 DC
32	Gen.Elec.	220/440 AC	180 cycle
30	Gen.Elec.	220/440 AC	250 DC
25	Gen.Elec.	220/440 AC	25 DC
20	Whse.	230 DC	110 AC
20	Star b.b.(2)	220/440 AC	250 DC
15	Gen.Elec.	220/440 AC	125 DC
10	Allis Ch.(2)	220/440 AC	250 DC

*Synch. motor drive.

D. C. MOTORS

HP	Mfr	Type	Volts	Speed
200	Cr.Wh. NEW	CMC	230	1750
200	Reliance	1970T	230	575/750
150	Cr.Wheeler b.b.	52H	230	1200
150	Cr.Wheeler b.b.	TEFC	230	800
100	Whse.	SK151	230	450/900
100	Gen.Elec.	C	230	575/1000
100	Gen.Elec.	RC36	115	1150
75	Cr.Wh. NEW b.b.	TEFC	230	900
75	Allis Ch.	E-149	230	500
75	Northw'n	K20	230	1750
75	Cr.Wh. New b.b.	CMC-HH	230	1150
60	Gen.Elec.	RC36	230	650
50	Burke b.b.	WA65	230	1750
50	Gen.Elec.	CD115	230	850
50	Gen.Elec. b.b.	CD115	115	1150
40/60	Whse.(2)	SK170	230	500/1000
40	Sprague dyna.	LC	230	750/2000
40	Whse.(2)	SK130	230	950
35/50	Gen.Elec.	CD123	230	575/1150
35	Ideal	DV350	230	400/1200
30	Reliance b.b.(3)	230T	230	850
30	Whse.	SK93	230	1750
30	Whse.	S-7	115	900
25	Gen.Elec.	RC31	230	1150
25	Gen.Elec.	CD85	230	1750
20	Gen.Elec.	RF12	230	400/1600
20	Whse.	SK93	230	1150
20	Gen.Elec.	CD85	230	1150
20	Whse.	SK130	230	500/1500
20	Reliance b.b.	TE	230	850
15	Whse.(3)	SK90	230	825
15	El.Dyn. b.b.	326	230	1750
15	El.Dyn. b.b.	158	230	300/1200
15	Whse.(2)	SK80L	230	1150
15	G.E. TEFC b.b.	CD83	230	1750

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
150	Cr.Wheeler b.b.	TEFC	250	1200
105	Century b.b.	1500 amp.	70	1200
100	Gen.Elec.	RC17	125	1200
100	Gen.Elec.	C	350	750
100	Allis Ch. 3 wire	MCW	120/240	1200
75	Cr.Wh. New b.b.(3)	HH	250	1450
75	Allis Ch.	E	250	750
75	Gen.Elec.(2)	RC36	125	1200
60	Gen.Elec.	RC36	250	850
50	Gen.Elec.	RC	250	850
50	Gen.Elec. b.b.	CDM	125	1450
40	Whse.	SK	250	1150
35	Northw'n	K	125	1150
30	Elec.Prod.(2)	BP	50	1150
25	Gen.Elec. b.b.	CDM96	25	1200
20	Whse.	SK93	250	1750
15	Star b.b.(4)	SQ	250	1750

EXPLOSION PROOF MOTORS

from 1 to 30 H.P. New & Rebuilt; std. speeds

A. C. MOTORS—25 CYCLE

HP	Mfr.	Type	Volts	Speed
150	Whse.	HF	440	500
150	Gen.Elec.	IK-16	440	750
50	Allis Ch.	ANY	440	750
50	Gen.Elec. int.	MTC5337	440	750
50	Gen.Elec.	I-K	440	750
50	Gen.Elec.]	KT339	440	1500
40	Gen.Elec.	KT343	440	750
20	Gen.Elec.	KT327	440	750
15	Whse. TEFC	CS365	220/440	1500

A. C. GENERATORS—60 CYCLE

KVA	Mfr.	Type	Volts	Speed
625	Gen.Elec.	ATB	2300	450
500	Allis Ch.	3 brg.	240/480	360
300	Gen.Elec.	ATB	240/480	720
250	Whse.	G	2400/480	600
225	Gen.Elec.	ATB	240/480	600
187	Gen.Elec.(2)	ATB	240/480	900
150	Gen.Elec.	ATB	240/480	900
125	Gen.Elec.	ATB	240/480	900
100	Gen.Elec.	ATB	240/480	900
56	Gen.Elec. (2)	ATB	240/480	1200
50	Gen.Elec.	ATB	240/480	900
31	Gen.Elec.	AT17B3B	240/480	1200
31	Whse.b.b.	G	120/208	1200
25	F.Morse	AB	220/440	1800
25	Whse b.b.	1 ph.	120/240	900

A. C. MOTORS—SLIP RING

3 Phase 60 Cycle 220 or 440 Volts

Qu.	HP	Mfr.	Type	Speed
1—	600	Gen.Elec.	I-M	360
1—	500	Allis Ch.	ANY	450
1—	400	Gen.Elec. 2300V.	IM-E153	1800
2—	300	Allis Ch. 2200V.	ANY	720
1—	300	Gen.Elec. 2200V.	I-M	1800
1—	250	Gen.Elec.	I-M	600
1—	250	Allis.Ch. 2200V.	ANY	514
1—	200	Gen.Elec.	I-M	360
1—	200	Gen.Elec.	I-M-17	600
1—	200	Gen.Elec. 2200V.	I-M-17A	450
1—	200	Allis Ch. 2200V.	ANY	720
1—	150	Gen.Elec. 2200V.	I-M-16	600
1—	150	Whse.	MW	450
1—	150	G.E. 2200/4000V.	I-M	1200
1—	150	Allis Ch.	ANY	600
1—	100	Allis Ch.	ANY	1800
1—	100	Allis Ch. b.b. NEW	ARY	600
1—	100	Whse. int. duty	CI-756A	720
1—	75	Cont. b.b. New	SN584	1200
1—	75	Gen.Elec.	I-M-E13	1200
2—	75	Gen.Elec.	I-M-14	720
1—	75	Gen.Elec. int. duty	MTC5342	900
1—	75	Ideal int.	AVE	1200
1—	75	Gen.Elec.	MT558	600
1—	75	Gen.Elec.	MT327	1800
1—	50	Allis Ch.	ANY	900
1—	50	Howell	SR437	1200
1—	50	Fair.Morse	BV	720
1—	50	Gen.Elec. int.	ITC5013	600
1—	50	Whse. int.	CI	600
1—	50	Gen.Elec.	I-M	720
2—	40	Gen.Elec. int.	MTC5526	900
1—	37	Gen.Elec. int.	ITC	600
1—	30	Lincoln		900
1—	30	Lancashire b.b.		1800
1—	30	Gen.Elec.	OMT336	1200
1—	30	Gen.Elec.	MT346	600
1—	25	Whse.	CW	1200
1—	25	Gen.Elec.	MT526	900
1—	25	Triumph	SR	1200
1—	25	Gen.Elec.	I-M	600
2—	20	Gen.Elec. int.	MTC5512	900
1—	20	Gen.Elec.	MT503	1800
12—	10	Reliance New b.b.	AW-324	1800

A. C. MOTORS—SYNCHRONOUS

HP	Mfr.	Type	Volts	Speed
300	Gen.Elec.	ATI	220/440	720
300	Whse.	G	2200/440	600
300	El.Machy.	late	220/440	514
220	G.E. 3 brg. .8 PF	ATI	220/440	600
200	G.E. .8 PF	ATI	220/440	900
150	Gen.Elec.	ATI	220/440	300
125	G.E. .8PF brg.	TS955	220/440	1200
125	Gen.Elec.	ATI	220/440	900
100	American b.b.	YGH	220/440	900

A. C. MOTORS—SQUIRREL CAGE

Phase 60 Cycle 220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1—	400	Whse. 2200V.	CS	1800
1—	300	Whse.	CS	1200
1—	250	Whse.	CS954A	720
1—	200	Whse. b.b. NEW	CS	1800
1—	200	Gen.Elec.	I-K	900
1—	200	Allis Ch.	AN	1200
1—	150	Gen.Elec. TEFC b.b.	K6333S	1200
2—	150	Howell b.b.	M584	1800
1—	150	Gen.Elec.	I-K-16	900
1—	150	Reliance b.b. NEW	B6085	1200
1—	125	Reliance b.b. NEW	C5085	1200
2—	125	Allis Ch. 2200V.	AN	1200
1—	125	Gen.Elec.	I-K-16	450
1—	125	Cont. 2200V. b.b.	SC	1800
1—	125	Gen.Elec.	KT339	3600
2—	125	Rel. TEFC NEW	B6085	1800
1—	100	Gen.Elec.	I-K-14	900
1—	100	Gen.Elec.	I-K	1800
5—	100	Allis Ch. 2200V.	AR226	1200
1—	100	Reliance b.b. NEW	C5085	900
1—	100	Rel. TEFC NEW	C5085	1200
1—	100	Gen.Elec. b.b. NEW	K5048	1800
1—	100	Cont. TEFC	NP682	1200
1—	100	Gen.Elec.	I-K-15	720
2—	75	Gen.Elec.	I-K	600
1—	75	Gen.Elec.	I-K-14	720
1—	75	Reliance b.b. NEW	C5084	900
1—	75	Reliance TEFC NEW	C5084	1200
1—	75	Reliance b.b. NEW	C505	1800
1—	75	Gen.Elec.	KT329Y	3600
2—	75	Reliance b.b. NEW	C505	1200
1—	75	Gen.Elec.	KT347	1200
1—	60	Gen.Elec.	KT552	720
1—	60	Gen.Elec.	KT346	900
2—	60	Reliance b.b. NEW	B504	1800
2—	60	Reliance TEFC NEW	C505	1200
2—	60	Reliance b.b. NEW	C504	1200
2—	60	Whse.H.T	CS504	1800
1—	60	Wagner b.b.	RP444	3600
1—	50	Allis Ch. b.b.	ARX445	1800
1—	50	Whse. b.b. NEW	CS4058	1800
1—	50	G.E. NEW b.b. HT	KG405	1800
2—	50	Reliance b.b. NEW	C445	1200
1—	50	Gen.Elec.	KT336	1200
1—	50	Gen.Elec.	KT342	900
1—	50	Whse. hislip	WL607	900
1—	50	Whse. b.b.	CS504	1200
1—	50	Gen.Elec.	KT352	600
2—	40	Gen.Elec. b.b.	KF504	900
1—	40	Gen.Elec. b.b.	KF404S	360
2—	40	Gen.Elec.	KT327	1800
1—	40	ALCh. 3 speed	ARX	900/600/450
4—	40	Gen.Elec.	KT336	900
2—	40	Reliance b.b. NEW	C404	1800
2—	40	Reliance TEFC NEW	C445	1200
3—	40	Gen.Elec.	KT522	1200
3—	30	Gen.Elec.	KT342	600
2—	30	Gen.Elec.	KT532	900
1—	30	ALCh. TEFC b.b.	ARZ445	900
2—	30	Howell b.b. 4 speed	SC	1800
2—	30	Gen.Elec. NEW b.b.	K365	1800
2—	30	Gen.Elec. NEW hitorq.	KG365	1800
2—	30	Gen.Elec. TEFC b.b.	K404	1800
1—	30	Gen.Elec	KT336	720
1—	30	Whse.	CS646	900
2—	30	Reliance b.b. NEW	C405	1200
2—	30	Reliance TEFC NEW	C444	1200
2—	25	Reliance TEFC NEW	C444	900
3—	25	Reliance b.b. NEW	C364	1800
2—	25	Reliance TEFC NEW	B365	1800
2—	25	Reliance b.b. NEW	C404	1200
2—	25	Reliance TEFC NEW	C405	1200
2—	25	Whse. NEW spl. b.b.	CS365	1800
3—	25	Whse.	CS646	900
2—	25	Gen.Elec.	I-K	600
2—	20	Gen.Elec. TEFC b.b.	FT512	1200
1—	20	Reliance b.b. NEW	C404	900
4—	20	Reliance b.b. NEW	C364	1800
2—	20	L.A. NEW exp.prt.	EX364	1800
2—	20	Whse. NEW b.b.sp.	CS364	1800
2—	20	Whse.	CS	1200

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TRANSFORMERS — 60 Cycle

QU.	KVA	MAKE	TYPE	PH.	VOLTAGES
1	5000	American	LT	3	27000/2300
2	4500	GE	HT	3	270p0/2300
1	1500	GE	HTI	3	4150/2300
1	1000	GE	Auto	3/2	4150 x 2406
1	1000	GE	Auto	3	3810Y-3300Y
2	750	GE	HTU	3	4150/480
1	500	Kuhl.	OISC	1	4000 x 2300V.
3	400	GE	H	1	6900 x 2250V.
1	300	Pitts.	ODSC	1	7800 x 440V.
3	300	GE	H	1	2400 x 120 /240
1	200	Whse.	Auto	3/2	4150 x 2300
1	200	Pitts.	OISC	1	4000 x 110/220
1	200	GE	Auto	3/2	4150 x 2400
1	150	GE	KS	1	2300 x 230
1	100	Pitts.		1	2750 x 110/220
3	100	Wagner	RCKV	1	240 x 120/120
2	100	Whse.	SK	1	4400 x 220/440 Taps
2	100	Newark	Dry	3/2	440 x 220
3	100	GE Pyrn.	H	1	4160 x 220/440
3	100	GE	Auto	1	4150 x 2300
1	100	Amer.	OC	1	15000 x 2300
3	75	GE	H	1	2400 x 220/440
3	75	Whse.	SK	1	2400 x 440
7	50	Whse.	SK	1	13750 x 125/250
11	50	GE	H	1	13750 x 125/216
5	50	Whse. Inert.	S	1	4150 x 120/240
2	37½	GE	H	1	2400 x 120/240
2	37½	AC Dry	AD	1	450 x 120
1	37½	Amer.	RS	1	13800 x 220/440
1	37½	GE	H	1	13800 x 220/460
1	37½	Amer.	OISCID	1	13200 x 220/440
3	27½	GE	Dry	1	440 x 220/110
12	25	Whse.	Dry	1	440 x 220/110
1	25	Maloney	Oil	1	230/460/220/110
2	25	GE	H	1	11500 x 240/460
1	25	Maloney	Oil	1	2400 x 120/240
1	18	GE	K		17500 x 440

A.C. GENERATORS
3 Phase, 60 Cycle

QU.	KVA	MAKE	TYPE	VOLTS	SPEED
1	2500	Whse.		2300	720
1	625	GE	ATB	600	3600
1	375	AC		480	450
1	300	GE	ATB	600	600
1	300	AC		240	3600
1	200	Whse.		240	600
1	225	Whse.		550	514
2	138	GE	ATB	240	600
1	170	Whse.		2200	900
2	80	Whse.		220/440	900
3	44	Columbia		240	1200
1	31	Amer.		120/208	1200
1	18.75	Star		230/440	1800
1	12.5	Whse.		240	1200

D.C. MOTORS

QU.	HP	MAKE	TYPE	VOLTS	SPEED
1	125	GE	RC	230	1700
1	100	GE	LC	230	625
1	80	GE	CDM	230	1750
1	75/100	CW	CMC	230	800/1000
1	75	CW	WP	230	860
1	75	GE	C	230	575
1	50	GE	CD	240	660/1300
1	50	CW	CM	230	700
1	40	GE	LC	230	700/1000

D. C. MOTORS (Cont.)

QU	HP	MAKE	TYPE	VOLTS	SPEED
1	35	GE	RC	230	860
1	30	GE	CDM	230	1600/1850
1	30	GE	RC	230	1150
1	30	GE	RC	230	1100
1	30	GE	C	230	625
1	30	GE	RLC	230	400/1200
1	25	Whse.	SK	230	825
1	25	Whse.	SK	230	600
1	25	Whse.	SK	230	400/1200
1	25	CW	CMC	230	335/670
1	25	Whse .	SK	230	300/1200

MOTOR GENERATOR SETS
3 Phase, 60 Cycle

QU.	KW	MAKE	SPEED	DC	AC
1	1000	Whse.	720	275	2300/4150 Syn.
1	1000	GE	514	600	2300/4150 Syn.
1	500	GE	900	275	2300/4150 Syn.
1	400	GE	900	275	2300/4150 Syn.
1	300	GE	1200	280	2300 Syn.
2	150	GE	1200	125/250	2300 Syn.
1	150	Whse.	600	125	4150 Syn.
1	125	CW	1200	125	2300 SC
1	100	CW	1200	125	220/440 SC
1	100	El. Mach.	1200	125	4150 Syn.
2	75	GE	1200	125	220/440 SC
6	75	GE	1200	60	220/440 SC
1	50	Ridgeway	1200	550	220/440 SC
1	50	Whse.	900	250	220/440 SC
2	40	El. Mach.	1750	125	440 SC
1	35	Ideal	1200	125	220/440 SC

OIL CIRCUIT BREAKERS

1—3000	A GE	15000V	3 pole	FK	130
1—3000	A GE	4500V	3 pole	FK	12
2—3000	A GE	600V	3 pole	K	25
1— 600	Whse.	7500V	3 pole	F	124 A
1— 400	Whse.	3700V	3 pole	O	221

SPECIAL DIESEL

1—300 KW De La Vergne Baldwin 6 cy. 4 cycle, 400 RPM, 125/250V.

SPECIAL

1—120 KW 150 KVA Ames Uniflow 16 x 16 220V, 3 ph, Non-Condensing.

NEW CONTROL

4—150 HP GE CR 7051 Sq. Cage Automatic 440V, 3 ph.

A.C. MOTORS
3 Phase, 60 Cycle
Synchronous

QU.	HP	MAKE	TYPE	VOLTS	SPEED
4	200/100	Whse.		4150	720/360
1	200	El. Mach.		2300	360
1	200	GE	TS	440	257
1	185	GE	ATI	2300	720
1	180	GE	TS	220	1800
2	150	AC		2300	360
1	100	GE	ATI	2300	900
1	70	El. Mach.		2300	180
1	35	GE	ATI	2300	1200
1	20	Whse.		220	1800

SLIP RING

1	2500	GE	MT	6600	257
1	500	GE	MT	2200	720
1	300	Whse.	CW	440	600
1	150	GE	IM	440	450
1	100	GE	IM	440	600
1	75	GE	MT	220	1200 Vert.
1	75	GE	MT	440	900
1	60	GE	MT	220	1750
1	60	GE	MT	440	900
1	50	GE	MT	220	1720
1	50	GE	MT	220	1200
1	50	Whse.	CW	220	900
1	50	GE	MT	220	1700
1	50	GE	MT	220	600
1	40	GE	MT	220	1200
1	40	GE	MT	2200	1200
1	40	GE	MT	220	900
1	40	GE	MT	2200	900
1	30	GE	M	220/440	1200

SQUIRREL CAGE

QU.	HP	MAKE	TYPE	VOLTS	SPEED
1	150	CW		2300	1200
1	125	GE	KF	2300	1800
1	125	US		440	1200 Vert
1	100	LA	RY	440	1800
1	100	Whse.	CS	440	1800
1	75	GE	KF	220/440	1200
1	75	Ideal	AT	220/440	1200
1	60	Whse.	CS	2200	900 Vert
1	60	GE	KT	220	1200
1	40	Whse.	CS	220	900
1	40/20	Whse.	CS	440	575/455
1	35	Whse.	CS	2300	1200
1	35	GE	IK	550	600
1	30	GE	KT	220	600
1	25	GE	KT	220	1165
1	25	GE	KT	440	1200

LARGE STOCK OF D.C. MOTORS AND GENERATORS, SWITCHBOARD AND CONTROL EQUIPMENT

JLHCo

This Seal is your Guarantee

J. L. HEMPHILL & CO.

1604 53rd STREET, NORTH BERGEN, N. J.

PHONE NEW YORK — LONGACRE 5-3227

PHONE NEW JERSEY — UNION 3-2600

Reliably Rebuilt Electrical Equipment

41st YEAR

MARCH SPECIALS — SLIP RING MOTORS

2—500 HP G.E.—3 ph., 60 cy., 2300v. 450 RPM
1—400 HP West.—3 ph., 60 cy., 2300v. 514 RPM

All with primary oil switches and magnetic secondary controllers.

Rebuilt — 1 YEAR GUARANTEE

PARTIAL LISTINGS ONLY

MOTORS
Squirrel Cage 3 Phase

H.P.	Make	Type	Speed
500	West. (2)	CS	1160
450	G.E.(vert.)	KF-6338	1180
300	G.E.	IK	900
250	G.E.	FT	3560
200	Wagner	RT2	1750
200	G.E.	KF-6335	880
150	West. (2)	CS	1750
150	West.	CS	580
125	Al.Ch. (2)	AR	435
100	Wagner New	XP	1150
100	G.E.	K-544	1175
100	West.	CS	870
100	G.E. (2)	IK	575
75	West.	CS	1750
75	G.E. (3)	K-505	1175
75	G.E.	IK	900
75	G.E. (3)	KT-352	865
75	West.	CS	720
75	G.E.	K-356	690
75	G.E.	KT-558	580
60	F-M	Tot. Enc.	1800
60	West. (2)	CS-607	880
60	Rel. (2)	AA	875
60	G.E.	KT-346	865
50	G.E.	FTR-523	3600
50	Elliott	196	3450
50	West.	CS	1740
50	L.A. (3)	XP	1150
50	West.	XP	1150
50	G.E.	KF-445	1170
50	West.	CS-642C	1160
50	West. (3)	CS	870
50	G.E. (2)	IK	870
50	G.E.	FTR-542	870
50	West.	CS	690

MOTORS
Slip Ring 3 Phase

H.P.	Make	Type	Speed
600	Cr.Wh.	131AQ	507
500	GE(2)	IM	450
400	West.	CW	514
225	Wagner	25 cy.	710
200	G.E.	MTF-557	1800
200	G.E. (2)	IM	1170
150	Wagner	31VRN	900
150	G.E.	MT-564Y	580
100	G.E.	MT-553	1165
100	Al.Ch.		690
75	West.	CW	1150
75	G.E.		690
50	West.	IIF	850
50	Al.Ch.		690
50	G.E.	MT-536	1150
50	West.	CW	1150
50	G.E.	MT-336	1150
50	L.A.	OGH	870
50	F-M	BV	600
50	Al.Ch.	ARY	575
50	G.E.	IM	490

MOTORS
Synchronous

H.P	Make	Type	Speed
475	West.		720
400	G.E. (2)	TS-928S	600
300	G.E.	ATI	900
260	G.E.	TS	900
200	G.E. (2	25 cy.	500
200	Ideal	SMW	257
180	G.E.	ATI	900
160	G.E.	TS	1200
145	G.E.	ATI	720
135	West.	G	1200
135	Ideal		1200
100	G.E.	TS	1200
55	El.Mchy.	BRKT	1200

MOTORS
550V. D.C.

H.P.	Make	Type	Speed
765	G.E. (6)	MPC	1045/1350

MOTORS
230V. D.C.

H.P.	Make	Type	Speed
400	A-C		415
135	C-W	CCM152H	233/900
125	G.E.	RC-15	1750
100	G.E.	RC-14	1750
100	Al.Ch.		1150
90/45	G.E.	RF-	950/475
75	Sprague		1000/1500
75	West. (2)	SK-180	475
75	Cr.Wh.	LT	480/670
75	Cr.Wh.	CMC	375/950
75	West.(3)	SK151	250/1000
60	West. (3)	SK-160	680
50	G.E.	RC-12	1750
50	Diehl		850/1050
45/90	G.E.	RF-17	475/1950
50	West. (3)	SK-160	565
50	G.E.	RF-17	250/1000
50	West.	SK	250/1000
40	West.	SK-103	1750
40	Century	DN-454	1740
40	G.E.	RC-31	1700
40	G.E.	RC-32	1100
40	G.E.	RC-34	750
40	G.E. (2)	CD-1441	400/1500
40	Cr.Wh.	CCM	700
40	Rel.	461T	400/1200
33	West.	SK-120	1150
33	G.E.	RLC	440/800
30	G.E. (8)	CDM-85	2200
30	West.	SK	975
30	Cont.	D-103	850
30	G.E.	RC-33	775
30	West.	SA	500/1500
30	West. (2)	SK-143	575
25	G.E.	RC-15	1750
25	West.	SK-83	1750
25	G.E.	*CDM-77	1750
25	E.D.	108	1500
25	Rel.	92T	1150
25	West.	SA	500/1500
25	West. (2)	SK-130	600
25	G.E.	RF 14	300/1200

MOTORS
115V. D.C.

H.P.	Make	Type	Speed
300	West.	SK	900
100	Cr.Wh.	CMC	900
40	G.E.	CD-113	850
30	West.	S	600
25	G.E. (2)	CD	1800
25	West.	SK-103	1150
25	Cr.Wh.	CCM	750
25	West.	SA	600/1200
15	E.D.	7½S	650/1230
15	Cr.Wh.	CM	650
12½	G.E. (3)	CDM-85	930/1160
12½	G.E.	*CDM-95	930/1160
10	Century	DN-334	1750
10	G.E. (2)	RC	1200
10	Al.Ch.		900
10	E.D.	7½S	425/1700
10	Diehl		230

GENERATORS — A.C.
Driven by D.C. Motors

KVA	Make	D.C. Input	A.C. Output
288	West	115	450
75	G.E.	230	240
50	Star	115	120
35	G.E.	230	220
31	Ideal	115	440
31	El.Mchy.	230	440
18	G.E.	230	120/240
10	Burke	115	120
7½	Hertner	115	440
5	El.Spec.	115	110
1¼	Al.Ch.	230	110

GENERATORS — A.C.

KW	Make	Type	Speed
216	West.	G	900
180	G.E.	ATB	900
100	G.E.	ATB	360
75	G.E. (2)	ATB	1200
50	F-M	GG	1200
15	G.E.	ASI	1200

Frequency Changers and Generators

Size	Make	Output Frequency
150 KW	G.E.	150 cy.
154 KVA	G.E.	150 cy.
50 KW	G.E.	120 cy.
40 KW	G.E.	100 cy.
30 KW	G.E.	90 cy.
15 KW	G.E.	408 cy.
10 KW	G.E.	200/700 cy.
7½ KW	G.E.	408 cy.
3 KW	G.E.	408 cy.

GENERATORS
600V. M D.C.

KW	Make	Speed
400	G.E. (4)	1200
200	Cr. Wh.	900
200	West.	1150
150	West.	1150
60	G.E.	1200
30	Burke	1750

GENERATORS
250V. D.C. Motor Driven

KW	Make	Speed
1000	G.E.	900
500	West.	1100
300	Elliott	1200
300	G.E.	1200
300	Al. Ch.	1200
200	G.E.	1200
150	West.	900
100	Delco	1200
75	G.E.	1200
50	G.E.	1200
40	Rel. (4)	1750
42	ABC (2)	1200
30	G.E.	1200
25	G.E.	1200

GENERATORS
125V. D.C. Motor Driven

KW	Make	Speed
250	G.E.	720
150	Cr. Wh.	1200
150	West.	1150
100	West. (2)	900
100	G.E.	1200
100	El. Mchy	1200
75	Cr. Wh.	1200
75	Hertner	1150
50	West.	1150
50	Cr. Wh.	1150
50	Sturt.	2800
35	Ideal	1200
30	G.E.	1150
30	L.A.	1450
25	El. Mchy. (2)	1150

GENERATORS
Low Voltage D.C.

Amp.	Make	Voltage
4000	Chandy.	6/12
5000	Optimus	6/12
1500	H-V-W	6/12
125	Hobart (8)	7½
1000	G.E.	15
750	Master	20
1500	Century	24
3000	El. Prod.	24
550	Col.	27
100	G.E.	30
1000	G.E.	33
150	Watton	40
200	G.E.	42
1500	G.E.	50
1500	Century	60
1500	G.E.	60
1000	G.E.	75

TRANSFORMERS

4—333 KVA Moloney, 2300/4600V. Primary, 230/460V. secondary.
1—300 KVA, Al. Ch. 3 ph, 41600V. Primary, 230V. Secondary.
1—300 KVA, Pittsburgh, 3 ph.
1—300 KVA, Pittsburgh, 3ph, 41600 V. Primary, 230V. Secondary.
8—100 KVA West. 3 ph. 440-220 Dry.
2—50 KVA G.E.—H—KF, 2400/4160Y—120/240V. Sec.
4—25 KVA West. 440V. Primary, 110/220V. Sec.
3—15 KVA West. 440V. Primary, 110/220V. Sec.
60—Additional Oil and Insulated Dry-type Transformers in stock, not listed, down to 1 KVA.

STARTERS — A.C.

1—450 H.P. West. magnetic reduced voltage (550V.) Synch.
2—400 H.P. C-H Bulletin No. 9976, 440V. magnetic reduced voltage Synch.
1—250 H.P. C-H Bulletin No. 9580, 4150V.
1—200 H.P. G.E. CR-7065, 440V. Synch.
3—150 H.P. G.E. CR-7061, 220V. Synch.
2—100 H.P. C-H full voltage Synch.
40—C-H and A-B, 2 and 4 speed magnetic starters.
635—7½ H.P. C-H 440V. magnetic starters.

STARTERS — D.C.

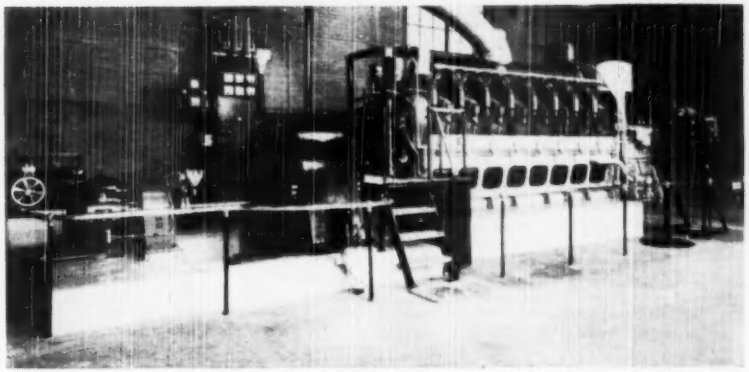
1—600 H.P. 230V. West. magnetic.
150—New 230V. D.C. magnetic starters, from 5 H.P. to 75 H.P., C-H, G.E., etc.
100—New 230V. D.C. manua starters from 1 H.P. to 5 H.P.—G.E. and C-H.
40—New 7½ H.P 230V. magnetic reversing.
1—300 H.P. West. 115V. magnetic.
Over 250 additional D.C. starters in stock, not listed, all sizes and voltages.

EST. 1910 — L. J. LAND INC. — 40th YEAR

156 GRAND STREET — Phone CAnal 6-6976 — NEW YORK 13, N. Y.

NO POWER SHORTAGE AT BROCKVILLE, CANADA

DIESEL POWER



DIESEL POWER

Last year the Public Utilities Commission of Brockville, Ontario, was experiencing a serious shortage of power and it became mandatory that a dependable source of power be added immediately. The Commission approached "AGSCO" and purchased the 1000 KW Remanufactured GMC Diesel Unit which is pictured above. This unit was shipped, installed and "on the line" in 58 days, a record of which to be proud.

Other power users in this region were also short of power and large "AGSCO Remanufactured Diesels" were installed for Kellogg Co. at London, Ont.; York Knitting Mills, Toronto, Ont.; Canadian Steamship at Montreal, Ont.; Utilities Commission of Woodstock, Ont. and City of Orillia, Ont.

Select dependable AGSCO Remanufactured Diesels for your power requirements today.

Save on Initial Acquisition Costs with "AGSCO REMANUFACTURED DIESEL EQUIPMENT"

UNITS AVAILABLE FOR IMMEDIATE SHIPMENT

KVA	MAKE	MODEL	HP	RPM	KVA	MAKE	MODEL	HP	RPM
1875	Fairbanks Morse	33F16	2000	300	312.5	General Motors	8-268A	450	1200
1420	Fairbanks Morse	38D	1600	720	312.5	Clark	MD-4	375	327
1250	General Motors	16-278A	1600	720	300	Fairbanks Morse	YVA	360	257
1250	Nelseco	6M1-53	1500	300	250	General Motors	8-268A	350	1200
1000	General Motors	12-278A	1200	720	200	Buckeye	80	240	600
937.5	General Motors	12-567	1080	720	187.5	Ingersoll Rand	S	225	514
625	Alco	6-12-1⅛x13T	750	600	156	Buckeye	E	190	400
425	Baldwin	VO	510	450	125	General Motors	3-268A	150	1200
400	Buckeye	80	480	600	121	Fairbanks Morse	32E14	140	300
375	Enterprise	DSG-6	450	450	75	General Motors	6-71	90	1200
330	Superior	KNA	396	514	62.5	Int'l Harvester	UD-18	76	1200
312.5	Cooper-Bessemer	FSN6	375	900	50	General Motors	4-71	60	1200

"SPECIALISTS IN DIESEL POWER"

Engineered AGSCO DIESEL POWER

A. G. SCHOONMAKER Company, Inc.

ESTABLISHED 1898

Diesel Engines • Power Machinery

52 CHURCH STREET, NEW YORK 7, N. Y. PHONE Digby 9-4350

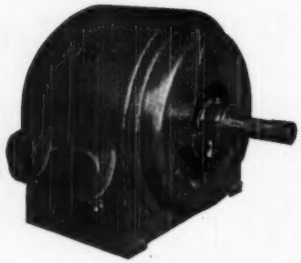
MOTORS - M.G. SETS - CONTROLS

AT REDUCED PRICES!

M-G SETS

KW	D.C. Volts	A.C. Volts	Mfg.
500	250	2200	C-W
400	125/250	2300	Ideal
300	250	2200	G.E.
300	125/250	440/2300	Allis (New)
200	250	2200	Whse.
200	125/250	2200	G.E.
150	250	440	G.E.
125	250	440	Whse.
100	250	220/440	Star (New)
75	250	440	C-W
60	250	220	G.E.
50	250	440	Whse.

Reconditioned and guaranteed



SLIP RING

NEW DIRECT CURRENT

230 Volt Drip proof — ball bearing

Qu.	HP	RPM	Mfg.	Frame
5	250	1750	A-C	149
1	75	1750	F-M	1509
1	75	400/1200	Rel.	6S1-T
2	30	850/1700	Rel.	230-T
3	10	1750	Rel.	34-T
5	7½	575/2300	G.E.	77-CD

Reconditioned and guaranteed

230 VOLTS D.C.

HP	RPM	Mfg.	Brg.
250	400/1200	E-D	Ball
200	300/900	Whse.	Ped.
200	400/1200	Rel.	Ball
150	350/1200	Whse.	Ped.
150	300/1050	C-W	Ball
125	400/1200	G.E.	Slv.
125	300/900	Rel.	Slv.
100	500/1500	C-W	Ball
100	475/1350	E-D	Slv.
75	500/1500	C-W	Ball
60	400/1200	Whse.	Slv.
50	350/1050	Whse.	Ball

SYNCHRONOUS

HP	RPM	Volts	Mfg.	Type
800	150	440	G.E.	80%
650	138	2300	Whse.	Engine
600	450	2300	G.E.	80%
500	600	2300/4160	G.E.	80%
500	514	440	E-M	100%
400	900	2300	Whse.	80%
400	720	440	G.E.	80%
400	600	440	G.E.	100%
400	514	440	G.E.	100%
350	900	440	G.E.	100%
350	200	2300	Whse.	100%
300	514	440	G.E.	100%
250	600	4160	E-M	100%
150	900	4160	G.E.	80%
75	900	220	E-M	80%

New 1250 HP 720 RPM G.E. MT 2300/3/60 Slip Ring Motor, with Hyd. Coupling and Magnetic Control.

2—New 500 HP, 1200 RPM Elliott, 220/440 V., 3 Ph., 60 Cy., Shaft 4½" dia. x 8" long. (Photo above).

NEW SLIP RING CONTROLS

12—250 HP 440/3/60 Fully Magnetic, Reversing, 7 steps acceleration, Allis-Chalmers, with air ckt. brkr. Open or enclosed.

SLIP RING — R & G.

HP	RPM	Volts	Mfg.
700	720	2300	Allis
500	450	2300	G.E.
450	514	440	Whse.
350	900	2300	Whse.
350	450	2300	Whse.
250	900	440	Whse.
200	1200	440	G.E.
150	900	2300	C-W
125	900	440	Whse.
125	720	440	E-M
100	600	2200	A-C

Buy from BOSWICK with confidence

WAlbridge 1195

BOSWICK ELECTRIC CO.

P.O. BOX 55 AKRON 9, OHIO

NORTHERN METAL CO.

BOILERS at REDUCED PRICES

IMMEDIATE DELIVERY

Yarrow 3 Drum Bent Tube
Max. Steam per hr. 65,000 lb.
Normal 55,000 lb.
Working Pressure 225 P.S.I.
Test Pressure 387 P.S.I.
Heating Surface 6256 Sq. Ft.

Cleaver Brooks
Fire Tube Marine Package Type 60 H.P.
100 lb. Max. Working Pressure
2,000 lb. Steam per hr. at 35 lb. pressure

Wickes Water Tube, 3 Drum
55,000 lb. Steam per hr. normal
65,000 lb. Steam per hr. max.
626 H.P.
Working Pressure, 250 lb.

Babcock & Wilcox Water Tube Boilers
22,500 lb. Steam per hr.
Working Pressure 250 P.S.I.
Heating Surface 4874 Sq. Ft.

NUMEROUS OTHER ITEMS ARE AVAILABLE FOR INDUSTRIAL USE

MILNOR & BLEIGH STS. • PHILA. 35, PA.
Phone MAyfair 4-1400

Compressors — Vacuum Pumps

A Good Name to Go Buy

"AMERICAN"

REBUILT — GUARANTEED

Save 40% to 60% One—Two—Four Stage

CFM	Pressure	Make	Model
29.5	250	Worth	BW500
40	500	IR	Type 20
61	1000	Worth	VB
105	350	CPT	T-CB
110	3000	IR	Type 40
140	125	Gardner Denver & Sullivan	WB and WL-80
170			
250			
285			
388	125	Worth	M-75
1055	110	IR	XRE
1290	125	Worth	VD
1452	70	Penn	DBI
2340	125	CPT	W-CE

All Makes — Many Other Sizes
Rentals For Experimental Work
PORTABLES — GAS — DIESEL

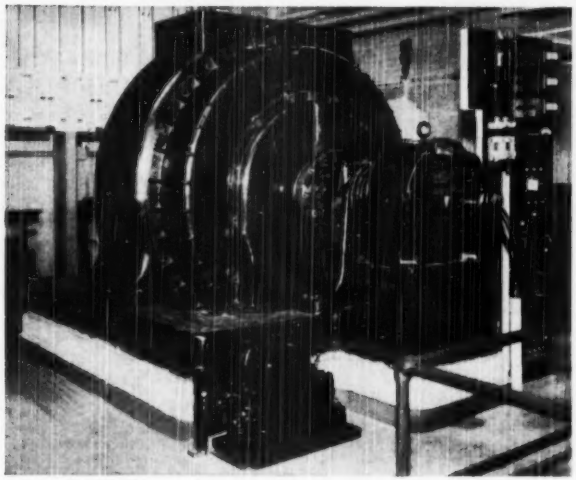
American Air Compressor Corp.
Dell Ave. & 47th St., North Bergen, N. J.
— *SINCE 1902* —

FOR SALE

1—40'x85'x40' Steel Building
2—100 & 300 HP F-M Diesel Elec. Sets
2—500 & 2000 cu. ft. Air Compressors
1—20 HP 125# Cyesthermo Boiler—like new
1—28x48" Heavy Duty Corliss Engine—ex.
2—286 HP Portable S. Marine Boiler Plant

H. & P., 6719 Etzel, St. Louis 14, Mo.

Generate Your Own Power With "UTILITIES APPROVED" EQUIPMENT



Actual Photograph

SYNCHRONOUS CONDENSER OR MOTOR

5000 KVA Westinghouse Electric Corporation 3 phase 60 cycle 4000 volt, 725 amperes, 720 RPM synchronous condenser Serial #4240814 equipped with a 125 volt, 280 amperes, Type SK, 720 RPM direct connected exciter, switchboard and instruments. Can be converted as a *synchronous motor* developing 4000 HP, at either 80 or 100% P.F.

EXCELLENT CONDITION — COMPLETE INSTALLATION — PROMPT DELIVERY

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

6250 KVA G. E. condens., 5 stage, 2300/4000 volts, 200# pressure, 800°TT, 3600 RPM.

5000 KVA G.E., non-cond. Automatic Extraction, 13,800 volts, 800# P.S.I. 750° TT 150# extraction and 25# gauge back.

3125 KVA G.E. condens. 130 P.S.I. 550 volts.

3125 KVA G.E. condensing 175/200 P.S.I., 2300 volt, 500° TT, 3600 RPM complete.

1875 KVA G.E. non-condensing 250# pressure, 30—50# gauge back, 480 volts, 3600 RPM

1563 KVA G.E. non-condensing 250 P.S.I. 25# gauge back, 2400 volts, 3600 RPM.

1563 KVA G.E. condensing 250 P.S.I. 2300 volts, 3600 RPM complete.

1560 KVA Allis ocndens. bleeder, 180-200 P.S.I. extraction 25,000# per hour, 240 volts.

1250 KVA Allis non-condensing 150 P.S.I. 10# gauge back 240/480 volts.

937 KVA Allis non-condensing 125 P.S.I. 10# gauge back 480 volts.

925 KVA G.E. non-condensing 150 P.S.I. 15# gauge back, 480 volts, 3600 RPM.

625 KVA Westinghouse condensing 150/200# pressure, 2300 volt, 3600 RPM complete.

625 KVA G.E. non-condensing 150# pressure 15# back, 2300 volts, 3600 RPM complete.

375 KVA (4) G.E. condensing 400# pressure, 480/600/2300/4150 volts complete.

112 KVA G.E. non-condensing 125# pressure 10# gauge back 480 volts.

100 KVA Westg. non-condensing 125 to 150# pressure, 10# gauge back, 2400 volts.

TURBINE-GENERATOR UNITS

Direct Current

400 KW (2) 240 volts direct current Crocker-Wheeler Worthington 440 lbs. condens.

150 KW (2) 3 wire, 250 volts, 225/250 P.S.I. Westinghouse-Worthington condensing.

75 KW Allis-Chalmers-Terry, 125 volts, 2400 RPM, 150# pressure non-condensing.

75 KW (2) Westinghouse-Moore 120 volt, 200# pressure, condensing.

60 KW (3) new Westinghouse 120 volt, 200# pressure, condensing.

SYNCHRONOUS MOTORS

3 phase, 60 cycle

5000 KVA Westghse. 4000 volt. 720 RPM

900 HP Allis, 2200 volts, 150 RPM

750 HP G.E. 2300 volt, 720 RPM

300 HP 80% P.F. G.E. 2300 volts, 720 RPM

MOTOR GENERATOR SETS

500 KW General Electric 600 volt DC, direct connected to 710 HP, 3 phase 60 cycle, 2300 volt, 720 RPM synchronous motor.

400 KW General Electric 275 volt DC, direct connected to 710 HP, 3 phase 60 cycle 2300 volts, 720 RPM synchronous motor.

300 KW Allis-Chalmers, 250 volts DC generator direct connected to a 430 HP Allis-Chalmers 3 phase 60 cycle, 440 volt, 1200 RPM synchronous motor.

150 KW G.E. 125 volt direct current generator direct connected 225 HP, 3 phase 60 cycle 220 volt, 1200 RPM synchronous motor.

62½ KVA G.E., 3 phase 60 cycle, 2300 volt, 1200 RPM alternator direct connected 75 HP, 125 volt DC motor.

STEAM ENGINE-GENERATOR UNITS

Direct Current

400 KW G.E. 240 volts, 360 RPM generator connected Skinner Unaflow vertical engine 150#, 10# gauge back.

275 KW Westinghouse 250 volt, generator connected Ames vertical Unaflow engine.

250 KW (2) G.E. 3 wire 250 volts generators connected Skinner Unaflow Engines.

100 KW Burke 3-wire, 250 volt generator connected Skinner Unaflow engine.

30 KW (2) G.E., 125 volts, 425 RPM generators each direct connected G.E. vertical engine 125 P.S.I.

STEAM ENGINE-GENERATOR UNITS

Alternating Current—3 phase, 60 cycle

1125 KVA—G.E. 480 volts, 150 RPM generator direct connected 28"x36" Nordberg Unaflow non-condensing engine 150-200# pressure, 5-15# gauge back.

625 KVA Westinghouse 240 volts, 150 RPM generator connected 28"x36" Skinner Unaflow Engine 125 P.S.I.

375 KVA G.E. 2300/440 volts, generator connected 23"x24" Skinner Horizontal Unaflow Engine 120—150 P.S.I.

175 KVA G.E. 240 volt generator connected Skinner Horizontal Unaflow Engine.

MARCH BARGAINS

1—New 8400 sq.ft. Ingersoll-Rand Horizontal surface condenser.

1—4400 sq.ft. Worthington surface condenser.

4—900 KW, 250/375 volt, 720 RPM Elliott direct current generators direct connected 1200 HP, 8 cylinders Model #38D8-1/8 opposed piston, 720 RPM Fairbanks-Morse Diesel Engines.

1—5425 GPM, 70 foot head Worthington Centrifugal pump direct connected to 125 HP G.E. 3 phase 60 cycle, 2300 volt, 1750 RPM G.E. slip ring motor.

2—1000 GPM, 1270 foot head, 4-stage, Morris Machine Works pumps each direct connected to a 417 HP, 3-stage, Form D-54, 3100 RPM 390# pressure non-condensing G.E. steam turbine.

UMC UTILITIES MACHINERY CORP.

1965 EAST 6th STREET • CLEVELAND 14, OHIO • Long Distance 422

FROM AVAILABLE STOCK

Rebuilt to N.I.S.A. Standards

MOTOR GENERATOR SETS

3 ph. 60 cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	1500	G.E.	600	125/250	4000
1	1500	G.E.	600	600	2300/4150
1	1500	G.E.	360	275	2200/4400
1	1250	G.E.	600	275	2300
1	1000	G.E.	720	250	2300/13200
1	1000	Whse.	900	250	2300/4150
1	1000	West.	514	250	4150
1	800	G.E.(3U)	1200	120/240	2300
1	750	Whse	900	250	2300
1	500	G.E.	720	600	2300/4150
1	500	G.E.	720	125	2300/4000
2	400	G.E.	720	250	440/2300
1	400	G.E.	1200	120/240	440
1	350	G.E.	900	125	2300/4150
1	300	G.E.	1200	250	440
1	150	Cr. Wh.	1200	250	440
1	100(3U)	Cr. Wh.	900	125/250	2300
1	100	G.E.	1170	125	220
1	75	Cr. Wh.	1170	250	220/440
1	75	Cr. Wh.	1200	250	550

ROTARY CONVERTERS

60 Cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	2000	G.E.	514	600	13800
1	2000	G.E.	450	600	2300
1	1000	Whse.	900	600	11000
1	750	Whse.	900	600	13200

RECTIFIERS

1	750	G.E.	BHW	575	2300
1	1000	A.C.	B-612	625	13500
1	1000*	A.B.B.	GBZ	625	6600/13200

*This unit with full automatic control good for both 25 and 60 cycle.

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4000	G.E.	Auto Extraction 250# ISP 15# Ext. 2400V. 3 ph. 60 cy.
1	2000	G.E.	Condensing. 175# ISP—6000V. 3 ph. 60 cy.
1	1000	G.E.	Condensing 135/150# ISP 2300/4150 V 3 ph. 60 cy.
2	750	G.E.	Condensing 250/275# ISP 440V. 3 ph. 60 cy. (New 1944)
2	400	G.E.	Condensing. 275# ISP Geared to 1200 RPM. 120/240V. D.C. Generator.
1	300	G.E.	Non-condensing 150/175# ISP 5/15# B.P. 480V. 3 ph. 60 cy.
1	200	Al. Ch.	Condensing 425# ISP Geared to 1200 RPM 120/240V D. C.
	200	Cr. Wh.	Condensing 250# ISP Geared to 1200 RPM—125V. D.C. Gen.
1	200	Whse.	Non-condensing 150# ISP 7# B.P. 240V. 3 ph. 60 cy.

TRANSFORMERS

60 Cycles

Qu.	KVA.	Make	Type	Ph.	Voltages
1	2500	Packard	AF	3	13800 x 2300
1	2500	Al. Ch.	OISC	3	13200 x 2300
3	1000	Pitts	OISC	1	13200 x 2300
3	1250	G.E.	H	1	6600 x 550
1	1000	G.E.	WGTH	3	11000 x 445
1	1000	Maloney	OISC	3	13200 x 480
1	600	Al. Ch.	OISC	3	4000/2300 x 216
3	333	Pitts	OISC	1	26400 x 2600
1	250	Al. Ch.	OISC	1	2200 x 1250
3	200	Whse.	OISC	1	7200 x 240/480
6	167	G.E.	OISC	1	2400 x 240/480

D. C. MOTORS

HP	Make	Type	Volts	Speed
1—1750	Whse.		600	525/720
1—1500	Whse.		525	600
1—1200	Whse.		600	425
1—800/1000	Whse.		450	600/720
1—650	G.E.	MPC	230	115/145
1—600	Al. Ch.	MILL	230	400/900
1—300/400	G.E.	DYNA	230	1325/2500
1—335	Whse.	MG	230	300/900
1—200/300	G.E.	MPC	230	350/920
1—275	Whse.	QM-600-6	230	425/850
1—250	G.E.	MPC	230	400/500
1—230	Al. Ch.		230	700
1—150	G.E.	MPC	230	250/450
1—150	G.E.		600	350/750
10—150	Cr. Wh.	83H	230	890

FREQUENCY CHANGERS

1—2000	G.E.	25/60 Cycle	2300/2300V
1—500	A.C.	25/60 cycle	11000/2300V

A. C. MOTORS

3 ph. 60 cycle

SYNCHRONOUS

HP	Make	Type	Volts	Speed
2—3500	G.E.	TS	2300	257
1—2100	G.E.	ATL	4000	514
2—2000	Whse.		2300	120
1—1000	Whse.		2300	150
2— 900	Al. Ch.	(New)	2200	150
1— 650	Whse.	NG	2300	138
1— 600	Whse.	Sym.	440	360
1— 500	G.E.	ATI	480	900
1— 500	G.E.	TS	4150	600
1— 450	Whse.	Eng.	2300	128.5
1— 350	G.E.	TS	2200	150
1— 330	G.E.	ATI	2300	600
1— 300	G.E.	ATI	440	720
1— 300	Whse.		2300	720
1— 300	Al. Ch.		440	600

SLIP RING

1—1000	Whse.	CW	2300	700
2— 700	Whse.	CW	2300	900
1— 500	G.E.	IP	550	365
1— 500	G.E.	IM-MIII	2300	450
1— 450	G.E.	IM	440	508
1— 400	G.E.	MT 412	440/2300	705
1— 350	Whse.	CW	2200	900
1— 350	G.E.	MT-442Y	2200/4000	253
1— 300	Al. Ch.	3 Brg.	2300	505
1— 200	G.E.	IM	440	720
9— 300	Al. Ch.	ANY	2200	705
1— 250	G.E.	MT-424Y	4000	257
1— 250	G.E.	MT-550S	2300	1750
4— 100	G.E.	MT-566Y	440/2200	425
2— 100	G.E.	IM-16	2200	435
3— 100	G.E.	IM	440	600
3— 100	Al. Ch.	AK	2200	1200

SQUIRREL CAGE

1— 250	G.E.	KT-559	440	800
1— 200	G.E.	IK	550	865
1— 200	G.E.	KT-557	440	1800
1— 200/112	G.E.	KF-559SS	440	1170/885
1— 125	Whse.	MS	440	485
1— 125	(New) G.E.	KF-TEFC	440	1190
1— 125	G.E.	KF-TEFC	440	3585
1— 125	Al. Ch.	AK	2200	1170
1— 100	G.E.	IK-Vert.	2300	450
3— 100	G.E.	KT-543	220/440	1750

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Type	Volts	Speed
1	9140	Whse.		4150	600
1	4000	G.E.	TSC	2400/4800	900
1	3000	Whse.		4800	720

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SPECIAL OFFERINGS

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1—New 10,000 KW 13,800 V. 60# Cd.
2—New 4000 KW 4160 V. 80# Cd.
1—3500 KW 550 V. 200# Cd.
1—2500 KW 550 V. 250# Cd.
2—1800 KW 2300 V. 400# Cd.
2—1000 KW 2300 V. 200# Cd.
2—1000 KW 480 V. 180# Cd.
1—750 KW 480 V. 150# NC.
1— 750 KW 240 V. 150# Cd.
1— 750 KW 550 V. 170# EX.
1— 465 HP Turbine 900#

BOILERS

2—50,000# 300#
1—30,000# 400#
1—623 HP—450#
2—500 HP—200#
1—487 HP—200#
2—250 HP—125#
2—220 HP—160#
1—72" HRT 150#

DEAERATING HEATERS

3—90,000# Pr. Hr.

ENGINE GENERATORS

1—500 KW 2300 V. Unit.
1—375 KW 2300 V. Unit.
1—168 KW 220 V. Unit.

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2—800 KW—2300 V.
2—200 KW—480 V.

COMPRESSORS

33,330 CFM—Cent. 7#
4900 CFM—Gas 50#
1700 CFM—100#
500 CFM—Diesel (2)

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1—3" Lagonda single filter
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160 K.W. Diesel Power Plant. 2—Engines—National Superior—600 R.P.M. 2—Generators—75 K.W. and 85 K.W. 250 volts, D.C. 2—15 K.W. Balancers, for 3 wire 125/250 volts. Automatic Switchboard—5 Panels. Booster M/G set—40 volts, 20 K.W. D.C. Cooling Tower—Evaporative Type—by Acme. Storage Batteries—116 Cells—Philco make. All in excellent condition, now running in mid-town Manhattan. Inspection invited. Will sell separate items.

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Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

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50,000 lb. Integral Furnace 400 lb. B & W boiler complete with pulverized coal burners.
1500 KW 2400 volt GE Cond. turbine nozzled 150 lbs. capable changing pressure up to 400 lbs.
285 KVA 240 volt Chase Uniflow engine set.
100 KW 250 volt GE Rotary Converter with 2300 volt transformers.
200-150-100 & 50 KW Syn. M. G. Sets 2200 AC 125 DC

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asme — BOILERS — nat'l. b'd.

3—404 H.P. Springfield sectional, oil
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2—500 H.P. Erie City, oil
2—400 H.P. Stirling type. Spreader stoker
3—84" | Suspended HRT, hand fired
3—72" |

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54-25—91st Street, Jackson Heights, N. Y.

Fairbanks Morse diesel electric generator sets, 1000 KW, late models, 2300/4160 v. (6).
General Motors 900 and 1600 HP diesel electric generator sets (4).
Nordberg EG diesel generator sets (2) 180 rpm, heavy duty, air injection, 870 KW, warranted.
Also diesel generators (3), 450 KVA, 675 HP, complete plant.
Steam 1500 KW turbo-gen. plant, A-1; $38,000.

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DIESEL GENERATORS-AC

3—150 KW 3 phase 60 cycle 460 V Westinghouse generators driven by *Buckeye diesels* model 80 at 600 RPM.

6—100 KW 3 phase 60 cycle 460 V Westinghouse generator driven by Worthington diesels model BBS at 600 RPM.

Available with switch gear, gasoline and motor driven starting compressors, excitation sets, regulators and valves. These are heavy duty generating plants in excellent condition. Some have never been used. Inspection invited.

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1—750 KW G.E. Syn. 250 V. 720 RPM
1—500 KW G.E. Syn. 250 V. 900 RPM
1—400 KW WEST. Syn. 600 V. 720 RPM
1—300 KW G.E. Syn. 250 V. 1200 RPM
1—200 KW G.E. Syn. 250 V. 1200 RPM
1—150 KW G.E. Syn. 250 V. 1200 RPM

ROTARY CONVERTERS

1—500 KW WEST. Syn. 250 V. 1200 RPM
2—300 KW WEST. Syn. 250 V. 900 RPM
1—300 KW G.E. Syn. 600 V. HCC 1200 RPM

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DIESEL GENERATOR SET!

225 HP Busch Sulzer Model DF, 3 cyl., 4 cycle, solid injection, 360 RPM. Direct erator with direct connected exciter, air connected 150 KW 3/60/2300 volt genfilter, muffler, etc. A modern unit in perfect condition only $4000 f.o.b. St. Louis.

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for Ventilating, Cooling, Heating, Drying, Blowing, Exhausting etc. Ideal for static resistance applications to 4" W.G. 9 sizes in stock 15"-36"; capacity 2000-30,000 cfm.

VERY ATTRACTIVE PRICES

direct connected waterproof motors, 3 phase 50/60 cycle 220, 380, 440, 500, 550 volt some DC also available in 115 and 230 volt.

COMPACT, QUIET, ECONOMICAL, VERY EFFICIENT

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VARIABLE VOLTAGE DRIVES

40 HP Reliance Variable Voltage Drives, each Consisting of:
1—40 KW 250 Volt, Induction M-G Set, with two auxiliary 5 KW generators and exciter.
1—40 HP 600/1500 RPM, Frame 385T, 230 Volt, DC Motor.
With full magnetic control providing leg forward, leg reverse, run, fast, slow, and stop, and motor operated field rheostat.

SLIP RING MOTORS—3 Ph., 60 Cy.

Qn.	H.P.	Speed	Volts	Make	Type
6	7½	810	550	G.E.	MTC-5201
2	10	1140	440	West.	HP-7A
2	10	570	220	G.E.	RH-11
2	11‡	820	550	G.E.	ITC-5008
2	15	1160	440	West.	CW-464C
2	15	570	220	West.	CW-646
1	18	680	440	West.	MW-316
2	20	986	440	West.	CW-628
1	25	1130	550	G.E.	MT-323
2	25	850	220	Wagner	BR
2	25	720	220	Wagner	22VBR
1	30	865	440	West.	CW-646
1	30	850	440	G.E.	MT-332
1	30	875	440	G.E.	MT-336
2	35	690	440	P-M	PM-316A
2	40	865	2200	Al-Ch.	ARY-225C
1	40	580	440	G.E.	MT-348
2	50	1150	440	G.E.	M-336
1	50	860	440	West.	HP-12A
1	50	570	440	G.E.	MT-352
5	52‡	550	220	G.E.	IQC-5013***
1	60	685	440	West.	CW-758
1	60	570	550	G.E.	MTC-5546
1	60	345	550	West.	CW-938
1	80‡	575	440	G.E.	MTC-5302
2	125	430	440	G.E.	IL-14
3	150	1750	440	G.E.	MTP-549
1	175	505	550	West.	CW-1002
2	200	600	550	G.E.	IM-17
1	200	495	550	G.E.	IM-17A
3	300	900	140	G.E.	IM-17
2	300	880	2200	G.E.	IM-17A
4	350	1775	2300	G.E.	IM-815A
2	350	880	2200	G.E.	IM-17A
1	400	505	550	West.	CW
1	600	1770	440	G.E.	IM-815C
1	650**	360	440	G.E.	MT-442T
1	700	735	4000‡‡	West.	CW

220 volt motors can be reconnected for 440 volts.
‡ Intermittent rating. *** 2 phase.
** New. ‡‡ 25 Cycle.

A.C. GENERATORS — NEW

3 Phase, 60 Cycle, 0.8 P.F., Two Bearing, with Damper Winding and Direct Connected Exciter.

Quan.	KVA	RPM	Make	Volts
4	18.7	1800	Columbia	240/120
5	18.7	1800	Columbia	208/120

230 VOLT CONST. SPEED D. C. MOTORS

Qn.	H.P.	Speed	Make	Type
10	3	850	Reliance	Y-23T
25	3½	850	West.	SK-30
1	7½	1150	G.E.	CDM-68
2	7½	1150	G.E.	CD-75
10	10**	1750	Kimble	BA-324
5	10**	1150	Al.-Ch.	EB-80
2	10	850	West.	SK-83
10	15½**	900	West.	SK-93
3	15	1750	G.E.	CD-75
5	15	825	West.	SK-90
1	20	1750	L.A.	ONA-LB51
1	20	1750/1310	West.	SK-85
2	20	1150	G.E.	RC-30
11	20	750	West.	SK-110L
17	25	825	West.	SK-120
1	30	1160	G.E.	RC-12
1	40	1760	West.	SK-103
1	40	750	G.E.	RC-36
1	50	750	West.	SK-150
1	50	650	G.E.	RC-16
1	60	1750/1310	West.	SK-143
1	150	700	Al.-Ch.	
2	300	1150	G.E.	RC-38
1	250	1150	C.W.	CMC-101A

230 VOLT ADJ. SPEED D. C. MOTORS

Qn.	H.P.	Speed	Make	Type
6	5/7½	600/1800	G.E.	RA-30
1	10	400/1600	Reliance	T-92T
2	10/15	600/3400	Reliance	T-92T
1	13½	280/840	West.	SK-130
10	13½**	600	West.	SK-93
1	15	500/1500	West.	SK-100L
1	20	500/1500	G.E.	RP-11
1	20/25	400/1600	Reliance	T-23-T
1	20/25	380/1200	West.	SK-153
1	25	400/1600	G.E.	RP-12
1	25	500/1500	G.E.	RP-12
1	25/29	300/1200	G.E.	RP-13
1	30	400/1200	West.	SK-163
1	30/40**	400/1600	G.E.	CD-1238
1	35	500/1500	West.	SK-143
1	40/50	400/1200	Reliance	T-1611
1	75	500/1500	Cr.-Wh.	CCM
1	75	375/750	Cr.-Wh.	CMC-125H
3	100	225/900	G.E.	MPC-A
5	100	400/1200	Al.-Ch.	
1	100	320/960	West.	SK-206
1	125	450/1000	West.	SK-190
1	175	250/500	West.	SK-220
1	275	350/500	G.E.	MPC

**New.

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy. Totally Enclosed Fan Cooled, Ball Bearing

Qn.	H.P.	R.P.M.	Volts	Make	Type
2	5	3480	220	G.E.	K-224
1	5	1750	440	L.A.	JA-284
10	5	1730	440	G.E.	K-254
2	7.5	1165	440	L.A.	JA-284
1	7.5	1740	440	G.E.	K-284
1	10	3480	440	West.	CS-324
1	10	1140	440	Wagner	CP2-326
1	10**	880	220	West.	CS-365EXPP
1	15	1745	440	West.	CS-326
1	15	1175	440	L.A.	JA-365
1	20	1760	220	G.E.	K-364
2	25	1760	220	G.E.	K-365
1	25	1760	440	G.E.	K-405
1	25	1170	220	L.A.	JX-405
1	25	705	440	West.	CS-W504
1	40	3565	440	G.E.	KP-4058

Splashproof, Ball Bearing

Qn.	H.P.	R.P.M.	Volts	Make	Type
23	5	1750	440	L.A.	FS-254
1	5	1735	220	G.E.	K-284
1	5	1160	440	L.A.	FX-284
1	10	3480	440	G.E.	K-284
1	15	1175	440	L.A.	JA-365
4	15	1150	440	L.A.	FX-365
2	40	1175	220	G.E.	K-445
3	50	1760	440	G.E.	K-448A
5	50	1160	220	G.E.	K-364
1	125	1770	440	L.A.	FX-1078Y
1	150	1775	440	L.A.	FX-1168
1	150	880	440	L.A.	FX-1368
1	150	700	440	G.E.	KP-6335
1	200	885	440	L.A.	FS-1378

Open Type Motors

Qn.	H.P.	Speed	Volts	Make	Type
1	15	3485	220	Reliance	AA-D3247
5	15**	1735	440	Century	SC326
1	15	1200	220	G.E.	KT-502
1	15	900	220	G.E.	FTR-512
1	20**	3475	220	West.	CS-326
5	20**	1750	440	Wagner	RP1-364
1	20	1750	220	West.	CS-W364
1	20	1200	220	G.E.	KF-517
2	20	1160	440	West.	CS-365C
2	20	900	220	G.E.	FTR-572
1	25	1800	220	G.E.	KT-512
3	25**	1740	440	Century	SC 365
1	25	1160	440	West.	CS-365C
1	25	900	220	Howell	FCHH-1[illegible]***
2	25**	875	440	Master	PH-305
2	25	575	440	G.E.	KT-512
1	30	3550	550	G.E.	K-5044
1	30	1160	440	West.	CS-444
1	30	870	220	West.	CS-445
1	40**	3515	220	G.E.	KF-4048
2	40	1750	440	West.	CS-585C
2	40	900	2300	G.E.	FTR-594
4	50**	1750	440	Wagner	RP2-365
1	50	850	220	West.	CS-445
2	60**	1750	440	Ideal	AH-444
2	60	900	440	G.E.	KT-516
1	75	1160	440	West.	CS-585C
1	75	870	220	West.	CS-765A
2	75	865	2300	G.E.	KT-572
1	100	690	220	West.	G
1	100	580	2300	G.E.	IK-15A
2	100	580	2300	West.	CS-320
1	100	495	2300	Al.-Ch.	AN
1	125	435	440	Al.-Ch.	AR
2	125	600	2300	G.E.	IK-17-FR
1	200	580	4550‡	G.E.	KT-5683
2	300	587	2200	West.	CS-79A
1	400	1165	2200	G.E.	IK-815B
1	600	1200	2300	G.E.	KTT-587
1	700	1800	2300/4000	West.	CS-4-39D-13

220 volt motors can be reconnected for 440 volts.
** New. *** 2 Phase. ‡‡ Reconnectable for 440 volts.

G. E. DYNAMOMETERS

Cradle Type, with Control and Dial Scale
(Write for Complete Specifications)

Qn.	HP	D.C. Volts	RPM	Type
1	50/75	250	1850/4000	TLC-20
2	100	250	1850/3600	TLC-30
1	200	250	1200	C

MOTOR GENERATOR SETS
125 and 250 Volts D. C.
(Write for complete Specifications)

KW	Make	RPM	D.C. Volts	A.C. Volts
2	Cont.	1750	125	220/440
7.5**	West.	1455	125	380/2300‡
10	West.	1750	125	220/440
10	West.	1450	125	220/440†
10	West.	1150	250	220/440
15**	G.E.	1800	125	220/440
15	G.E.	1750	250	220/440
15	West.	1450	125	220/440†
16	West.	1750	125	2200/440
20	West.	1750	250	220/440
25	G.E.	1800	250	220/440
25	G.E.	1200	125	220/440
30	G.E.	1800	250	220/440
30	Al.-Ch	1750	125	220/440
50	West.	1750	250	220/440
50	G.E.	720	125	220/440†
75	G.E.*	1200	125	220/440
75	G.E.	1200	250	2200/440
100	Columbia*	1200	250	2300/440
150	West.*	1200	250	2300/440

Note: 3KW, 5KW & 7.5 KW, 250 V. Beta Avail.
** New * Synch. Motor Driven. † 50 Cy. ‡ 25 Cy.

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment is Located in Our Cleveland Warehouse. We Have Controls for Most Items Listed.

ELECTRIC GENERATOR & MOTOR CO.
4521 HAMILTON AVE. CLEVELAND 14, OHIO

THE HOME OF VALUE AND QUALITY FOR . . .

ELECTRICAL POWER EQUIPMENT

YOU CAN DEPEND ON CHICAGO ELECTRIC

FOR GUARANTEED QUALITY AT LOW PRICES

HERE'S A PARTIAL LISTING OF OUR GIANT STOCK OF "REBUILTS"

SLIP-RING MOTORS

3 Phase, 60 cycle
220 or 440 volt
(*2200 volt or higher)

H.P.	Make	Type	Speed
1000	*Westg.	CW	720
600	G.E.	IM	550
500	*Westg.	CW	600
400	*G.E.	IM	900
300	G.E.	IM	1200
300	*G.E.	IM	1800
250	Westg.	OW-32M	900
150	Al. Ch.	ANY	600
125	G.E. NEW	M-6334	720
125	G.E. NEW	M-6333	900
100	G.E.	IM	450
75	G.E.	IM	514

SQUIRREL CAGE MOTORS

3 phase, 60 cycle—220 or 440 volt
(*2200 volt or higher)

H.P.	Make	Type	Speed
750	*G.E.	KT	720
500	G.E.	KTP-567	1200
500	G.E.	IK	900
400	Al. Ch.	ANW	900
350	G.E.	IK	600
300	G.E.	FT-559A	1800
250	Westg.	CS	900
200	Reliance	AA-C6085	1200
200	Westg.	CS-32B	720
200	Westg.	CS-950A	600
150	Westg.	CS-771-3C	1750
150	Westg.	CS-950A	600
125	G.E. TEFC	K-63268	1200
100	Burke	EM-12.5	1200
100	G.E.	K-6353	720
75	G.E. TEFC	K-565	1200
75	G.E. NEW	K-565	1200
75	*Westg.Vert.	CS	900
75	*G.E.	IK	720
60	G.E. BB	K-4418	1800
60	GE TEFC	K-4458	1800
60	G.E. BB	K-5041U	1200
50	Al. Ch. BB	AR-445	1800

SYN. A.C. MOTORS

3 phase, 60 cycle
240 or 480 volts

H.P.	Make	Type	P.F.	Speed
1000	Westg.		.8	900
700	G.E.	ATI	.8	720
450	El.Mach.	440/220	1.0	240
375	Westg.		.8	1200
320	Al. Ch.	Dr. Prf.	1.0	720
250	Al. Ch.		1.0	720
200	Al. Ch.		1.0	360
145	G.E.	ATI	.8	600
125	G.E.	TS-9548	1.0	1200
125	Cr. Wh.	103-8	1.0	900
100	G.E.	TS-9548	.8	1200
100	G.E.	ATI	.8	900

MOTOR GENERATOR SETS

K.W.	Make	A.C.	D.C.
1000	G.E.	4600	275
500	G.E.	2300	250
500	Cr. Wh.	4000	575
500	G.E.	440	250
500	G.E.	4000	1200
450	G.E.	2300	250
200	Cr. Wh.	2300	125
200	G.E.	440	250
150	Al. Ch.	220	125
75	Star	440	250
75	G.E.	440	250
60	Al. Ch.	2300	110
60	Fr. Morse	220	125
50	Westg.	220	110
40	Cr. Wh.	220	125
40	Westg.	220	230
40	Reliance	440	250
30	Cr. Wh.	220	250
20	G.E.	440	250
20	G.E.	440	125

2 COMPLETE VARI-VOLT DRIVES

M.G. Set. 200 K.W., D.C. gen., Elec. type MPC, 250 volts, 800 amps. 1200 RPM, dir. conn. to 300 HP syn. motor, Gen. Elec. Type TS, 3 ph. 60 cy. 440 volt, .8 PF., 1200 RPM.

D.C. Motor, 250 HP, Gen. Elec. type MPC, 245 volts, 730/975 RPM, with complete starting and control panels.

LOW VOLTAGE—M.G. SETS

1500 Amp., 60 v. Chandrn., 600 RPM syn. motor dr. 440 V. with exc.

1500 Amp. 60 v. G.E., 1200 RPM sq. cage dr., 2300 volt.

1000 Amp. 40 v. Chandyn., 600 RPM syn. motor dr., 440 volt, with exc.

333 Amp., 45 v. Col., 1800 RPM sq. cage dr., 440 volt.

TURBINE SETS

K.V.A.	Make	Press.	AC-Volt
1250	Gen. Elec.	250-NC	2300
900	Gen. Elec.	150-C	440
650	Kerr-Al Ch.	MIX	2300
312	Moore-C.W.	400-C	400
30	DeLaval-CW	150-NC	220

SPECIAL BARGAIN—OVER 60% SAVING

Never Unrated Surplus Equipment—25 K.V.A. Le Roi, Model PE-84C gasoline electric power plant Westinghouse, single phase, 60 cycle, 120 volt A.C. generator .8 P.F. Complete including radiator, generator control panel, fuel tank, etc., mounted on welded steel sub-base.

AN OUTSTANDING BUY

A REAL BUY

Like New Condition of these Transformers Gives You a 60% SAVING

6—750 KVA Westinghouse, air cooled net work transformers, Class B. winding, 3 phase, 60 cycle, Primary 13,800 V. with 4—2½% Taps Secondary — 460 volt. Impedence 5.1 Cont. 75° rated Units complete with 3 position high voltage disconnect switch and pot heads.

IMMEDIATE DELIVERY

CHICAGO ELECTRIC

Has a modern up-to-date plant where all equipment is fully and skillfully rebuilt and houses a tremendous stock of . . .

- AC MOTORS
- DC MOTORS
- GENERATORS
- M.G. SETS
- CONVERTERS
- COMPRESSORS
- SWITCHBOARDS
- TRANSFORMERS
- CONTROLS
- PUMPS

If you have an electrical power problem write us specifications and full information and we will be pleased to serve you.

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CANAL 6-2900

First Source for 40 Years for Quality Electrical Equipment

CHICAGO Electric Co.

1320 W. CERMAK ROAD — CHICAGO 8, ILL.

DRAG SCRAPER: Sauerman 3 yd. Crescent Drag Scraper Outfit complete with 150 H.P. motor and controls.

COAL PULVERIZER: NEW, UNUSED, Babcock & Wilcox, capacity 7500 lbs. of coal per hour, 125 H.P. motor, complete.

CARS: 20 yd. capacity, all steel, air dump.

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Lansdowne Theatre Building
LANSDOWNE, PA.
Phila. Tels.: Madison 3-8300, 3-8301

For Sale

BROS WATERTUBE BOILERS

IMMEDIATE DELIVERY

1—25,000# 250# PSI
1—15,000# 160# PSI

for SPREADER STOKER or OIL FIRING

Automatic Combustion Eqpt. Co., Inc.
P.O. Box 1478, Rochester, New York

FOR SALE

150 HP FYNN WEICHSEL SYNCHRONOUS MOTOR

900 RPM, 3 phase, 440 Volts 60 cycles. Complete with control equipment.

ELECTRIC APPARATUS REPAIR COMPANY
1400 No. 6th Street, Phila. 22, Pa.

ELECTRICAL CABLE

- for every industrial and power application
- Special constructions. Odd lengths.
- Large stocks on hand of high voltage, lead covered cables not ordinarily stocked by your regular suppliers.
- Cut to length. Reasonably priced.

UNIVERSAL WIRE AND CABLE CO.
2568 N. Clybourn Ave., Chicago 14, Ill.

U. S. GOVERNMENT SURPLUS

TWO 160# BOILER PLANTS COMPLETE
7—250 HP B&W Type H Stirling O&G
3—315 HP C-E Type VM Stirling O&G
All auxiliaries, Republic instruments. Boilers available individually. Also tanks, air compressors, pumps, elect. motors, motor control, all kinds steam and electric power equip.

Send for list

BILL J. BISHOP
Box 173 — McGREGOR, TEXAS

TRANSFORMERS

FOR SALE

2— 150 KVA. 60 CY. 1 PH. 2400-240/480 SCOTT TAPS.
6— 100 KVA. 60 CY. 1 PH. 2400-240/120.
6— 75 KVA. 60 CY. 1 PH. 2400-240/120.
9— 50 KVA. 60 CY. 1 PH. 2400-240/120.
7—37½ KVA. 60 CY. 1 PH. 2400-240/120.
8— 15 KVA. 60 CY. 1 PH. 2400-480/240.

ALSO ALL TYPES OF AIR COOLED AND PHASE CHANGERS.

ATLANTIC TRANSFORMER CO.
5143 N. 2nd St. — Philadelphia 20, Pa.

FOR SALE

Westinghouse SRA2 Silverstat Voltage Regulator 80 ohms 2.6 amps; 40 H.P. 550 v. D.C. magnetic starter Westinghouse; 20 H.P. 550 v. D.C. 1250 RPM G.E. motor; 3 H.P. 1800/900 RPM U.S. Varidrive motor 3 phase 220/440 volts; 3 H.P. 1800 RPM TEFC Explosion Proof motor Class I Group D G.E./3 phase 220/440; 1½ KW 7½ volt, 200 amp Plating Generator Set 220 v., 3 phase; 25 KVA Air Cooled Transformer 440/220 primary, 220/110 secondary.

Industrial Wiring Service
398 S. Clay St., Denver 9, Colorado

POWER EQUIPMENT—READY TO SHIP

A.C. MOTORS—3 PH. 60 CY.

No.	HP.	Make	Type	Speed	Volts
1 NEW	200	West.	SYN	1200	220/440
1	250	Burke	SYN	720	2200
1 vert	250	G.E.		1175	2200
1	200	G.E.	I	880	2200
1	200	G.E.	SYN	1800	2200/550
1	175	West.	MS	1200	220/440
1	150	West.	SYN	257	220/440
1	150	West.	SYN	600	220/440
1 NEW	150	El. Machy.		720	4160/2300
1	150	West.	SYN	900	2300
1	150	G.E.	I-K	1200	2200/220/440
1	150	West.	MS	1200	220/440
3	150	Louis Allis	FX	1750	220/440
1	125	West.	hi-torq	1115	220/440
4 NEW	125	West.	SYN	1200	220/440
1	125	G.E.	I-K	900	220/440
1 NEW	125	G.E.	TEFC	890	2200/440/220
1 NEW	125	Elec. Mach.		580	2300/440
1	125	Elec. Mach.	SYN	164	220/440
1	125	West.	TEFC	3600	220/440
1	112	West.	SYN	1200	220/440
1	100	Reliance	IT	695	220/440
1	100	G.E.	I	720	220/440
1	100	Al. Chal.		720	220/440
1	100	G.E.	I-K	900	220/440
1	100	G.E.	I-K	900	2200
1	100	West.	hi-torq	835	220/440
1	100	West.	SYN	900	220/440
1	100	Cr. Wh.	SC	1180	2200/220/440
1	100	Louis Allis	OGS	1750	220/440
1 NEW	75	Al. Chal.	AR	865	220/440
1	75	Stanley		600	220/440
1	75	Al. Chal.		540	220/440
1	75	West.	CS-877C	660	220/440
1	75	G.E.	I-K	600	220/440
1	75	G.E.	I-K	720	2200
1	75	G.E.	I	720	220/440
1	75	Louis Allis	OGS	1200	220/440
1	75	Burke		1200	220/440
1	75	Louis Allis	FAA-505Y	1150	220/440
2	75	West.	CS (TEFC)	1750	220/440
1	60	Al. Chal.		515	220/440
1	60	G.E.	I-K	600	220/440
1	60	Cr. Wh.	SC	720	220/440
5 NEW	60	West.	CS-607	900	220/440
		(EXPLOSION PROOF — TEFC)			
1	60	Burke		900	220/440
1	60	Triumph		1200	220/440
1	60	G.E.		1800	550
1	60	Elec. Dyn.	drip pr.	3600	4000/2300
2	50	G.E.	RT-546	720	220/440
1	50	Cr. Wh.		900	220/440
1	50	Wagner	Fynn Weichel	900	220/440
1	50	Triumph	B	850	220/440
2	50	West.	CS	900	220/440
2	50	G.E.	RT	1200	220/440
2 NEW	50	Reliance (TEFC)	B-504-S	1750	2200
3 NEW	50	G.E. (TEFC)	K-504	1750	2200
1 NEW	30	West.	CS-445 hi-torq	900	220/440

SPECIAL BARGAINS
Diesel Engine Generator Sets

10—100 kw., 120/240 v. D.C. Delco Generators dir. con. to 150 HP Model GBD-8, 5½x7, 8 cyl. Superior DIESEL Engines, elec. start with engine panels

4—100 KW same as above with 220 or 440 v. NEW A.C. Generators

1—63 kva. 120/208 v. 3 ph 60 cy. 1800 rpm., driven by Caterpillar DIESEL mt'd on trailer

2—75 kva. 220/440 v. 3 ph. 60 cy. Delco Cummins DIESEL

2—37½ kva., 220/440 v. 3 ph. 60 cy. Buda DIESEL

10—NEW 37½ kva., 220/440 v. 3 ph. 60 cy. LeRoi Gasoline

1—31.3 kva. 120/208 v. 3 ph. 60 cy. G.E. Gen. driven by LeRoi GASOLINE

11—NEW 25 kva. 120/220 v. 1 ph. 60 cy. Le Roi GASOLINE

1—12½ kva. 120/240 v. 1 ph. 60 cy. 1200 rpm., dir. con. Hercules GASOLINE

4—12½ kva. 120/240 v. 1 ph. 60 cy. dir. con. LeRoi Gasoline Engines

1—7½ kva. 120 v. 3 ph. 60 cy. Wisconsin GASOLINE

6—3 kva. 110/220 v. 1 or 3 ph. Hercules GASOLINE

SLIP RING MOTORS—3 ph. 60 cy.

No.	HP.	Make	RPM	Volts
1	500	Westg.	585	4600
1	400	G.E.	450	2200
1	250	Cr. Wh.	600	440/220
1	100	Triumph	580	550/440/220
1	75	G.E.	1200	220/440
1	60	G.E.	570	220/440
1	60	Westg.	900	220/440
1	60	Burke	1200	220/440
1	50	G.E.	570	220/440
1	50	Allis Chal.	690	220/440
3	50	Westg.	870	2200
1	50	G.E.	960	220/440
1	50/32	G.E.	800/640	220/440
1	30	Elec. Dy	1165	220/440

VARIABLE SPEED MOTORS—230 V. D.C.

No.	HP.	Make	Type	RPM
1	200	Westg.	SK-210	500/750
1	125	G.E.	CD	400/1200
1	100	Westg.	SK-190	500/1000
1	100	G.E.	CD-185	400/1200
1 NEW	60	Westg.	CD	850/1760
1	50	Westg.	SK-170	350/1050

DIESEL & GASOLINE COMPRESSORS

1—315 cfm Ing. Rand portable 100# pres. driven by 105 hp. Waukesha Oil Engine.

1—315 cfm Schramm 100# pres dir con. Buda Gasoline Engine rubber pneumatic tires

2—105 cfm Penna. 100# pres. driven by Buda Gas Engines

1—105 cfm Ing. Rand portable with Waukesha Engine

A. C. GENERATORS—3 ph. 60 cy.

No.	KVA.	Make	RPM	Volts
1 new	250	Westg.	1200	220/440
4 New	100	West.	1200	220/440
1	100	Elec. Mach.	164	220/440
1	100	Westg.	600	220/440
1	75	Elec. Mach.	900	220/440
10 New	37½	West.	900	220/440
11 New	25	West. (single Phase)	900	120

MOTOR GENERATOR SETS—250 V.D.C.
Motors 220/440 volt or 2200 volt 3 phase, 60 cycle

No.	KW	Make	RPM
3	250	Westinghouse	1200
1	200	Westinghouse	720
2	200	Westinghouse	1200
1	100	Westinghouse	720
1	100	General Electric	900
1	100	Westinghouse	600
1	100	General Electric	1800
1	100	Reliance	540
1	100	Delco	1200
3	99	Westinghouse	600
4	75	Westinghouse	720
1	75	Westinghouse	1200
1	60	Westinghouse	1200
3	30	Westinghouse	720
1 NEW	30	General Electric	1800
5	40	Westinghouse	900
9	30	Westinghouse	720

125 V. DC M.G. Sets

1—100 kw. G.E. 125 v. 900 rpm. 220/440 v. 3 ph. 60 cy. AC Syn.

1—75 kw. West. 125 v. 1200 rpm. 220/440 v. 3 ph. 60 cy. Syn.

BRAND NEW TURBO SET

Westinghouse Steam Turbine consisting of 200 kw., 230/440 v., 3 ph. 60 cy. 1200 rpm., 80% P.F. A.C. Generator—40 kw., 120 v. 1200 rpm., D.C. Exciter and Westg. Reduction Gear.—Non-cond.

SPECIAL BARGAIN AIR COMPRESSOR

6—249 CFM Westinghouse type 3 VB-23 3 cyl. vert., 150 lbs. pres. dir. con., to 50 HP., 220/440 or 2200 v. 3 ph. 60 cy. West 5Hp Ring Motors, auto. control. Can furnish D.C. Motors or Oil or Gasoline Engines if desired.

WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US.

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

GENERATOR SETS

100 KW 200 KW

General Motors Diesel engines, 8 cyl., Model 8-268A, 6¼" bore x 7" stroke. Direct conn. to: 200 KW WESTINGHOUSE ALTERNATORS, 3 phase, 60 cy., 440 V., including switchboards.

ALSO—COMPLETELY REBUILT

3 cylinder General Motors Diesel Engine Sets Direct Conn. to: 100 KW CENTURY ALTERNATORS, 3 phase, 60 cy., 440 Volt, Inc. switchboards.

OTHER SIZES IN STOCK FROM 10 to 1000 KW. Ready for immediate shipment.

ALJOHN DIESEL CO., Inc.
904 Pacific St. Brooklyn 16, N. Y.
Sterling 3-6575

FOR SALE

MODERN 1000 KW Turbo-Generator

in Excellent Condition

Non-Condensing, Steel case 80# back pressure .8 P.F., 3 phase, 60 cycle, 4150/2300 volts, alternating current, complete with accessories, switchboard, oil circuit breaker, and direct connected exciter. Only operated alternately for six years. Ideal for Chemical, Rubber, Petroleum, Textile, Pulp and Paper, and Sugar Refining Industries.

NEWMAN & COMPANY, INC.
739 Drexel Building Philadelphia, Pa.

DIESEL GENERATOR PLANTS

COMPLETE WITH SWITCHBOARDS

1000 KW to 100 KW

STATIONARY and PORTABLE

AT GREATLY REDUCED PRICES

NEW UNIT GUARANTEE

HERCULES ELECTRIC MACHINERY and EQUIPMENT CO.

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Compton, Calif.

SPECIAL TRANSFORMERS — YOUR SPECIFICATIONS

NEW TRANSFORMERS
OIL COOLED
AIR COOLED
PHASE CHANGERS

ARROW TRANSFORMER CO., INC.
1932 E. Westmoreland St., Philadelphia 34, Pa.
GArfield 5-0488

USED TRANSFORMERS
REWOUND
REBUILT
RECONDITIONED

BREW-WOLTMAN OFFERS

TURBINE UNITS

1—12500 KVA Al. Ch. Cond. 60 cy. 6900 V. 250-lb. 600 deg. Surface Condenser.
1— 5000 KVA G. E. Non-C. 60 cy. 13200 V. 600-lb.
1— 3125 KVA Worthington Non-C. 60 cy. 2300 V. 150-200 lbs., 40 lbs. BP.
1— 2500 KVA G. E. Extraction Cond. 60 cy. 480 V. 185-200 lbs. steel valve chest.
1— 1563 KVA G. E. Extraction Cond. 60 cy. 480 V. 200-lbs.
1— 1250 KVA Allis Cond. 60 cy. 2300 V. 150-200 lb.
1— 125 KVA West. Non-C. 60 cy. 240/480 V. 150-lb., 5-lb. BP
1— 25 KW Allis Non-C. DC 125 V. Exciter Dual drive turbine & motor.

ROTARIES — 60 Cy.

1—2929/3705 KW Gen. Elec. 225/285 V.
1—2160/2700 KW Gen. Elec. 240/300 V.
1—1000 KW Westinghouse 600 V.

DIESEL ENGINE UNITS

2—1600 HP Fair. Morse 60 cy. 2300 V. NEW gen.
1— 600 HP Fair. Morse 2400 V. 60 cy.
1— 400 HP DeLaVergne 2400 V. 60 cy.

STEAM ENGINE UNITS

1—1125 KVA Nordberg Uniflow. 480 V.
1— 312 KVA Ames Uniflow, 240 V.
1— 250 KVA Ames Vertical Uniflow, 480 V.
2— 187 KVA Ames Vertical Uniflow, 240/480 V.

DIESEL SPECIAL

3—700 HP General Motors Winton 8 cyl. 4 cy. 360 RPM dir. con. To 485 KW .8 PF 3/60/2300 V. generators.

SYNCHRONOUS MOTORS — 60 Cy.

1—600 HP G. E. 440 V. 360 RPM
2—500 HP E. M. 2200 V. 514 RPM
1—350 HP G. E. 440 V. 900 RPM
2—350 HP G. E. 2300 V. 257 RPM
1—300 HP G. E. 2300 V. 600 RPM
1—300 HP West. 2300 V. 900 RPM
1—200 HP G. E. 220 V. 600 RPM

INDUCTION MOTORS — 60 Cy.

2—450 HP West. S/C 4150 V. 360 RPM
1—300 HP West. S/R 2200 V. 1770 RPM
1—250 HP G. E. S/R 2200 V. 1800 RPM
1—200 HP Cr. Wh. S/C 2300 V. 720 RPM. NEW.
1—200 HP G. E. S/R 2200 V. 435 RPM
1—150 HP Cr. Wh. S/C 440 V. 900 RPM. NEW.
1— 75 HP Al. Ch. S/C 440 V. 900 RPM
1— 75 HP Cr. Wh. S/C 220/440 V. 1200 RPM

MOTOR GENERATOR SETS

2—1500 KW West. 250 V. DC 60 cy.
2—1000 KW G. E. 600 V. DC 60 cy.
2— 300 KW G. E. 250 V. DC 60 cy.
1— 75 KW Star 240 V. DC 60 cy.
1— 75 KW West. 125 V. DC 60 cy.

MERCURY ARC RECTIFIERS

2—4500 KW Multi Anode 600 V. DC
2—3250 KW Ignitron 650 V. DC

FREQUENCY CHANGERS

1—2500 KVA G. E. 25/60 cy. 300 RPM
1—1250 KVA West. 25/60 cy. 300 RPM
2—1000 KVA G. E. 25/60 cy. 300 RPM
1— 500 KVA Al. Ch. 25/60 cy. 300 RPM

TRANSFORMERS — 60 Cy.

1—4500 KVA G. E.	66000—33000, 3 ph.	
3—1000 KVA West.	66000—11000	
3—1000 KVA West.	66000—7200	
1—5000 KVA West.	34500—13750, 3 ph.	
1—3000 KVA G. E.	33000—2300/4000, 3 ph.	
1—3000 KVA West.	33000—2300/3890, 3 ph.	
6— 50 KVA G. E.	33000—2300	
6— 75 KVA Moloney	33000—2300/6900	
3—3750 KVA West.	26400/13200—2400	
4— 450 KVA Al. Ch.	25410/44600—13280/23000	
1—7500 KVA G. E.	13800 Rectifier Type	
2— 200 KVA G. E.	11500—220/110	
3— 200 KVA Moloney	11000—2300	
3— 167 KVA G. E.	7200/12400—240/480	
1—1500 KVA West.	4000—2300, 3 ph. Auto	
3— 250 KVA Al. Ch.	2300—460	
3— 500 KVA Pittsburgh	2300—230/460	

OIL CIRCUIT BREAKERS

1— 500 A. 73 KV G. E. FHKO-138		Outdoor
1— 400 A. 37 KV G. E. FHKO-136-CS		Outdoor
1— 400 A. 37 KV Condit FO-40-B		Outdoor
1—1200 A. 34.5 KV G. E. FKO-339-1000		Outdoor
4—2000 A. 23 KV G. E. FKO-339-1000		Outdoor
4— 600 A. 15 KV G. E. FHKO-138BS		Outdoor

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & CO., INC.

50 Church Street — New York City 7, — WOrth 4-1470

PACKAGE BOILERS

2—100 H.P. and 1—200 H.P. CYCLOTHERM STEAM GENERATORS, 125 lbs. PK. Completely automatic. For either gas, light or heavy oil. Mfg. in 1947.

FACTORY REBUILT — 90 DAY FACTORY GUARANTEE

AT A SAVING OF ⅓ OF NEW FACTORY UNIT

USED EQUIPMENT DEPT.

J. PARKER THOMPSON CO., Inc.

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MUrray Hill 7-6547

two 100 KW 250 Volt DC Generators. Steam driven by Ball Engines—140# pressure.

one 200 KW 250 Volt DC Generator. Steam driven by Ball Engine—140# pressure. Units complete with DC switchboard and two balancer sets.

one 20 ton York Vertical Ammonia Compressor. Steam driven by Corliss Engine—140# pressure.

one 15 ton York Vertical Ammonia Compressor. V belt drive. 33 H.P.—DC motor. Complete with condenser, receiver, valves, gauges, etc.

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BOILER

Union Iron Works, 535 h.p. horizontal tubular Boiler, 3 drum, A.S.M.E. Code, 199# steam pressure, complete with the following: Superheater, boiler motor, soot blowers, electric eye, coal pulverizer, steel coal bin and bucket conveyor, new 1930, condition good. Sacrifice for quick sale.

Surplus & Salvage Co., Inc.
Jamestown, N. Y.

FOR SALE

Bargain, complete Diesel Power Plant for cheap and emergency power, consisting of 300, 150 and 75 KW; 3 ph.; 60 cy.; 2400 v. units. Fairbanks Morse Modern Unit; Engineering service available.

Diesel, 821 K of P Bld., Indianapolis Ind.
Tel. Lincoln 4067

FOR SALE

Used Overhead Cranes
Structural Steel Buildings

Inquiries Invited

BENKART STEEL & SUPPLY COMPANY
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STEEL STORAGE TANKS

2—1000 & 2—10,000 Bbl. New Vertical
6—74,000, 55,000 & 37,500 Bbl. Vert.
8—25,000 Gal. Cap. Horizontal
50—10,000 & 3—20,000 Gal. Horizontal
6—10,000 & 12,000 & 16,000 Gal. ¾" Shell
20—10,000 Gal. Cap. 60 lbs. Press. Test

L. M. STANHOPE, Rosemont, Penna.

FOR SALE

1—Automatic Fyr Feeder spreader Stoker, complete with electrical equipment; 220 v. 3 PH 60 cycl., used for 18 months. Original price $3,500.00, will sell for $500.00.

PIERCE STEAM LAUNDRY
32 Eagle Street, Brooklyn 22, N. Y.

POWER EQUIPMENT

2—3 cyl. 129 HP, 250 RPM, Winton Diesel Eng.
4—Allis Chal. 15 KW 120 V. DC Gen. DC Waukesha Eng.
4—Broderick 125 HP, 325 psi, Stoker boilers.
1—150 kva E/M 2300 V. AC, Gen. DC Skin, S Eng.
3—150 HP Kewanee 1942 Firebox boilers. Complete.

KINSLOW POWER & EQUIP.
STRODE BLDG., TULSA, OKLA.

Generator Voltage Regulators

New — Used — Sold — Exchanged — Rebuilt

Westinghouse Silverstat General Electric GDA Allis Chalmers Rocking contact for A.C. and D.C. generators all sizes for quick delivery.

WESTERN REGULATOR EXCHANGE
1730 Wazee St. Denver 2, Colo.

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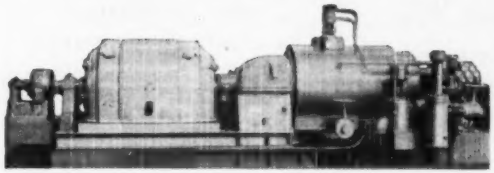

2500 KVA ALLIS CHALMERS CONDENSING TURBO UNIT

2000 KW 80% P.F. 2500 KVA Allis Chalmers Generator, 3 phase 60 cycle 4160/2300/600/480 volts, direct connected to 2000 KW Allis Chalmers condensing turbine, 400# steam pressure, 650° TT, 3600 RPM.

Equipped with direct connected exciter, surface condenser and auxiliaries.

This unit is designed for hign efficiency. The full load steam consumption is approximately 11# steam per KW hour.

New 1933—Excellent Condition—Can be shown in operation

TURBINE GENERATOR UNITS
3 phase 60 cycle

6000 KVA (2) G.E., 600# steam, 2400/4160 volts.
5000 KVA G.E., 600# steam, 150# extraction, 50# exhaust, 13800 volts.
2250 KVA (2) G.E., 400# steam, 2300/480 volts.
1563 KVA G.E., 250# steam, 20# exhaust, 2400 volts.
1250 KVA G.E., 400# steam, 2300/4150 volts.
937 KVA G.E., 200# steam, 25# extraction, 480 volts.
750 KVA Murray 275# steam, 30# exhaust, 240 volts.

UNIFLOW UNITS — *3 phase 60 cycle*

750 KVA Skinner Vertical, 150# steam, 5# exhaust, 2300 volts.
625 KVA Skinner, 150# steam, 5# exhaust, 240 volts.
500 KVA Skinner, 150# steam, 5# exhaust, 450 volts.
375 KVA Skinner, 150# steam, 5# exhaust, 2300 volts.
312 KVA Skinner, 140# steam, 5# exhaust, 480 volts.
250 KVA Ames Vertical, 150# steam, 5# exhaust, 480 volts.
187 KVA Skinner, 125# steam, 3# exhaust, 2300 volts.

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INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. Telephone: MAin 9514 CLEVELAND 14, OHIO

BOILERS

3—300 HP B.&W. 200# press.
2—250 HP Kewanee 125# press.
1—150 HP Erie Economic 150# press.
2— 80 HP Erie Economic 125# press.
1— 75 HP Leffel Scotch 125# press.
Also other sizes in stock. Reconditioned.
Immediate delivery.

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1600 N. Delaware Ave., Phila. 25, Pa.

FOR SALE

7 Panels—Modern G.E. Metal-clad 15 KV switch gear at approximately half price
1000 KW G.E. Turbo unit and condenser
Two 2000 GPM pumps with motors.
I-R Compressor 20,000 cfm at 100# pressure
Motor-driven Blower—1000 cfm at 4 lbs.
Room 4200, 310 South La Salle St., Chicago 4, Ill.

IMMEDIATELY AVAILABLE

New—Unused—Unerected—Complete
Babcock & Wilcox Water Tube Boilers

1—600 P.S.I. 740° F. Superheat 150,000 lb. per hour maximum 110,000 lb. per hour normal complete with oil burners.

1—600 P.S.I. 740° F. Superheat 115,000 lb. per hour maximum 85,000 lb. per hour normal complete with oil burners.

Also specialize in
Diesel Generators—Turbo—Generators
Write—Wire—Phone

DEAN G. STRICKLER & ASSOCIATES
1346 Conn. Ave., N.W., Washington, D. C.
Dupont 5386

MOTORS—M.G. SETS—TRANSFORMERS

SQUIRREL CAGE MOTORS
3-PHASE 60-CYCLE

Qu.	H.P.	Make	Type	Volts	RPM
1	400	G.E.	I-S	2300	514
1	400	G.E.	KT-412	2200	435
1	250	Whse.	CS	2200	1160
1	200	Al.Ch.	AK	220/440	580
1	150	C.W.	126Q	220/440	870
1	125	Whse.	CS-761C	220/440	1750
1	125	Whse.	CS-7728	2200	1170
2	125	C.W.		220/440	430
1	125	Al.Ch.	AR	220/440	435
1	100	G.E.	IK	220/440	1755
9	100	Whse.	CS-663C	220/440	1750
1	100	Al.Ch.	AR-226	2200	1160
1	100	G.E.	KT-556	2200	885
5	100	F.M.	H8	220/440	880
1	100	Al.Ch.		550	720
1	100	F.M.	H-241B	220/440	480
1	75	Whse.	CS	440	1750
1	75	Al.Ch.	AR	2200	1765
1	75	Burke	EM-10	550	720
8	50	Whse.	CS	220/440	890

SLIP RING MOTORS
CONSTANT DUTY
3-PHASE 60-CYCLE

Qu.	H.P.	Make	Type	Volts	RPM
1**	2000	G.E.	MT	2300	240
1**	1500	Al.Ch.	ANY	2200	220
2**	1000	Al.Ch.	ANY	2200	235
1**	800	G.E.	MT-12	2200/6600	600
1**	600	G.E.	MT-412	2200	720
1	500	G.E.	IM	2200/4400	590
1	500	Whse.	CW	2300	575
1	500	Whse.	CW	440	600
1	400	G.E.	IM	2300	875
1**	400	G.E.	IM	2300	590
1**	400	Al.Ch.	ANY	2200	505
1	400	G.E.	MT-424	2300	353
1	400	G.E.	MT	440	360
1	300	G.E.	IM	2200	1200
1	300	Al.Ch.	ANY	2200	505
1	250	Whse.	CW	2200	580
1	200	Al.Ch.	ANY	2200	585
1	200	Whse.	CW	550	514
1	150	G.E.	IM	440	495
1	125	Whse.	CW	2200	870
1	125	Al.Ch.	ARY	220/440	900
1	75	G.E.	IM	220/440	695
1	50	G.E.	MT-336	2200	1150
1	40	Al.Ch.	ANY	2200/440	425

**Mill type pedestal bearing design.

MOTOR GENERATOR SETS

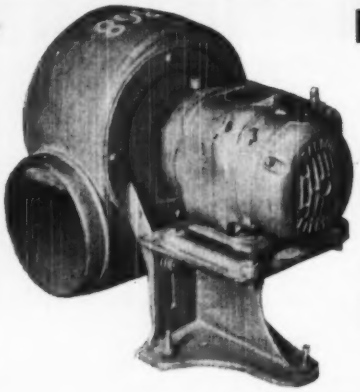
Qu.	KW	Make	RPM	Volts DC	Volts AC
2	1500	G.E.	600	600	4160/2400
1	1000	Whse.	514	600	4160/2400
1	1000	Whse.	514	660	2300
1	750	Whse.	514	275/300	2200
1	600	Al.Ch.	900	250	2300
2	500	G.E.	1200	600	550
1	500	G.E.	1200	600	2300
1	400	G.E.	1700	275/300	2300
1	300	Whse.	1200	120/240	2300/440
1	300	G.E.	720	125/250	2300/440
2	150	C.W.	900	250	2300/440
1	100	C.W.	900	250	2300/440
1	55	C.W.	1200	250	440
1	75	Whse.	1200	125	440/220
1	75	Al.Ch.	900	250	2300
1	75	Whse.	1200	250	2300/440
1(3U)	50	Whse.	1200	120/240	440/220
1	35	G.E.	1800	125	440/220
1	30	Reliance	1800	250	440/220
1	25	Whse.	1200	120/240	440/220
1	15	Al.Ch.	1800	250	440/220
1	9	G.E.	1800	250	440/220
1	——	Reliance variable voltage set (2) 30-KW 250-VDC Gen with (1) 5-KW exciter and (1) 75-HP motor 440/220.			

TRANSFORMERS
POWER DISTRIBUTION

Qu.	KVA	Make	Type	Phase	Voltage
2	4500	G.E.	HS	3	27000/13500-2300
5	1000	Pitts.	OISC	1	23000/11000-1100/2300
4	500	G.E.	H	1	13200/11880-220/440
3	333	G.E.	H	1	6900/11950Y-230/460
3	200	Pitts.	OISC	1	13800-220/440
3	150	G.E.	H	1	19000/9500-550/2200
6	100	G.E.	H	1	4160/2200Y-120/240
3	100	Whse.	Auto	1	2400/1385
3	75	G.E.	EF	1	2400/4160Y-120/240
3	50	Al.Ch.	OISC	1	23000/220
2	50	Wag.	HE	1	13200/11850-575/287

T. B. MAC CABE COMPANY

4312 CLARISSA ST. PHILADELPHIA, PENNA.



FOR SALE

Vent Air Blowers

Size V-20-9-2000 CFM

Sirroco Type—Slightly Used. Direct Connected to 1 HP Baldour Motor Type 20 BIM 3/60/220/440/1755 RPM, TE-FC

NEW COST $125.00
SALE PRICE $55.00

GLAZER BROS.

ANDERSON - - - - - - - - INDIANA

PH. 20233

- MOTORS, M-G SETS
- GENERATORS
- TRANSFORMERS
- FREQ. CHANGERS
- CONTROL EQUIPMENT

ALL SIZES, ALL TYPES, ON HAND, in our large and varied stock. QUICK DELIVERY.

Telephone: MAin 4-5900

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87-93 Jay St. • Brooklyn 1, N. Y.

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7000 DEMAND REGISTERS

General Electric Types M-14 & M-20; Westinghouse Types DR & RW; Sangamo Type HCB. All 120 V., 60 cycle, 30-minute. Large assortment of ratios.

E. N. GOODMAN

10 E. 23 St., New York 10, N.Y. Tel. AL 4-2954

BOILERS & STACKS

1—Union Iron Works Type L 3950 sq. ft. surface, 300 psig WP 3-drum, WT, complete with gas burners, feedwater controls, breeching and 5' 6" x 125' ¼" welded plate stack.

Condition: Excellent
Price: $10,500.00

2—Stacks, 5' 6" ID x 125' ¼" Plate Welded Steel, *Excellent Condition.*

Price: $300.00 each
Location: Alice, Texas

Purchasing Department

Southern Minerals Corp.

P.O. Box 716, Corpus Christi, Texas

LOW VOLTAGE M. G. SETS

1—2000/1000 amp; 6/12 volts
Hanson Van Winkle
Munning—AC Motor driven

1—2500/1250 amp; 6/12 volts, Elec. Prod. Co. AC Motor driven

Many other low voltage sets available from stock. Write for complete list.

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4— 200 HP B&W Sectional headers
1— 410 HP Heine Box header
2— 400 HP B&W Sectional header
2— 500 HP B&W Sectional header
2— 500 HP B&W Springfield
1—1400 HP B&W Sectional header
3—10,000# Red Flash heating boilers
Locomotive fire box from 45 to 110 HP

NATIONAL BOILER & EQUIPMENT CO.
1501 So. Senate Ave., Indianapolis 25, Ind.

Vertical Hydro-electric Units

1—500 K.V.A. 3 ph. 60 cy. 2400 v. 200 R.P.M. complete for 77' to 30' hd.
1—250 K.V.A. 3-60-2400 V 150 RPM for 12'-15' hd.
1—225 KW 3 ph. 60 cy. 2300 v. 180 RPM for 18-22' head
1—312 K.V.A. 3 ph. 60 cy 2400 v. 1800 RPM for 17-20' hd.
1—144 KW 3 ph. 60 cy. 550 v. 120 RPM for 9-13' head
1— 80 KW 3 ph. 60 cy. 2300 v. 300 RPM for 12-22' head.
1—1500 KW Vert. unit complete for 50' hd.
2—600 KW units horiz. for 50' hd.

Several horizontal units in good condition priced to sell. All subject to prior sale. We are headquarters for good hydroelectric units. For full particulars write

WM. C. MOULTON ASSOCIATES
MONSON, MASS.

FREQUENCY CHANGERS

—250 KVA Fairbanks-Morse 360 cycle/sync. motor drive.
—100 KW Elec. Prod. Co., 180 cycle/sync. motor drive.
— 25 KW Gen. Elec., 240 cycle/squirrel cage motor drive.

Generating equipment of every description available. Your inquiry will get prompt attention.

Telephone: MAin 4-5900

EMPIRE ELECTRIC COMPANY, INC.

87-93 Jay St. • Brooklyn 1, N. Y.

NEW "SEARCHLIGHT" ADVERTISEMENTS

received by March 3rd will appear in the April issue subject to limitations of space available. Address copy to the

Classified Advertising Division

POWER

330 West 42nd St., New York 18, N. Y.

MOTORS • GENERATORS • TRANSFORMERS

MOTORS
3 PHASE—25 CYCLE—220/440 VOLTS

H.P.	Make	Type	Frame	RPM
150	Gen. Elect.	IK-17		365
150	Gen. Elect.	IK-16		480
150	Gen. Elect.	IM-16	Slip Ring	480
150	Allis Chalmers			1450
150	Gen. Elect.	KT	517	1435
200	Westinghouse	CS	2200 volt	1500
350	Westinghouse	CW	Slip Ring	500
500	Gen. Elect.	IK		485
600	Gen. Elect.	MT	Slip Ring	490
600	Westinghouse	CS		490

HIGH FREQUENCY M-G SET

250 KW G.E. single phase 4600v., 960 cy., 3600 RPM, direct connected to 375 HP G.E. induction motor 3 ph., 60 cy., 440 v. Complete with motor starting equipment, generator and exciter panel.

350 KW GENERATORS

2—350 KW G.E. generators type MPC, 250 v. D.C. 720 RPM single bearing machines.

DIRECT CURRENT EQUIPMENT

125 or 250 v. motors and motor generator sets in all sizes.

6250 KVA TURBO-GENERATOR

1—6250 KVA Gen. Elect. Unit—Generator 3 Phase, 60 cycle 2300/4160 Volts 3600 RPM. Complete Installation For Immediate Delivery.

200 HP SYNCHRONOUS MOTOR

200 HP Gen. Elect. Synch. Motor—New 3/60/2300/225 RPM—1.0 PF Engine type with M-G set for exsitation and 200 HP Gen. Elec. New Full Voltage Syn. Dead Front Control Panel.

700 KW M.G. SET

2—350 KW Gen. Elect. Type MPC 250 volt, 720 RPM Generators will direct connect to 1000 HP Synchronous Motor or will sell Generators separately.

200 KW M.G. SET

200 KW Westinghouse NEMA Frame Generator 250 Volt DC, 1200 RPM, direct connected to
300 HP Westinghouse Synchronous motor 3/60/208/1200 RPM, A.C.—D.C. Panels—Like New

Immediate Shipment.

SLIP RING MOTORS
3 Phase—60 Cycle—220/440 Volts

H.P.	Make	Type-Frame	Speed	Remarks
3— 20	LaL	KH	900	
20	G.E.	MT-365	1800	
20	Cr. Wh.		1800	
3— 25	West.	CW	585	
25	G.E.	MT-343	690	
25	West.	MW	880	
40	West.	CW-748A	690	
6— 40	G.E.	MT-526	1200	
40	G.E.	MT-523	1800	
50	G.E.	MT-536	1200	
50	G.E.	MT-527	1800	
2— 50	West.	CW	1800	
60	G.E.	MT-533	1800	
60	West.	CW-653C	1800	
100	West.	CW	435	3 bearing
3—100	G.E.	I form M	900	
3—100	G.E.	MT-347	1200	
125	G.E.	I form M	1200	
3—250	G.E.	I form M-16	900	
350	West.	CW	435	2200 volts
500	Al. Ch.	ANY-WR	514	2200 volts
600	G.E.	MT	490	25 cycle

This motor will rewind satisfactorily to
700 G.E. MT 720

HORIZONTAL & DUPLEX
Compressor & Vacuum Pumps after Coolers, Filters

NEW TRANSFORMERS
Stock Shipment

3—25 KVA Niagara O.I.S.C. 2400/120/240, 1 Phase, 60 cycle, with taps.
6—25 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
3—37½ KVA Niagara O.I.S.C. 2400/120/240, 1 Phase, 60 cycle, with taps.
6—37½ KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
3—50 KVA Niagara O.I.S.C. 2400/120/240, 1 Phase, 60 cycle, with taps.
6—50 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
4—75 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
9—100 KVA Niagara O.I.S.C. 2400/120/240, 1 Phase, 60 cycle, with taps.
5—100 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
6—150 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
3—167 KVA Niagara O.I.S.C. 2400/120/240, 1 Phase, 60 cycle, with taps.
3—250 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase 60 cycle, with taps
3—333 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.

TRANSFORMERS

3—100 KVA Gen. Elect. Transformers. Type H Form K—2400/4160 volts primary 120/240 volts secondary. Price $450.00 each. Electrically O.K. F.O.B. truck, Minnesota.
3—50 KVA Gen. Elec. Transformers. Type H Form K—1 Phase 60 Cycle 2300 Volts Primary 115/230 Serial No. 3154838.
3—300 KVA Westinghouse Transformers. Type SK—1 Phase 25 Cycle 2300 Volts Primary 115/230 Volt. Secondary. Serial No. 1314000-90-91.
3—100 KVA Kuhlman OISC 60 cy., 1 phase, 11,000v. primary, 240/480v. secondary.
1—50 KVA Kuhlman OISC 60 cy., 1 phase, 11,000v. primary, 120/240v. secondary.

FREQUENCY CHANGERS

All Sizes in Stock. 60 cycle to 90 cycle, 180 cycle, 120 cycle, 180 cycle and any other high cycle.

ERIE ELECTRIC CO., INC.
124 CHURCH ST. BUFFALO, N. Y.
CL. 4758

NEW and REBUILT
MOTORS
GENERATORS
TRANSFORMERS
1 to 1500 H. P.
ELECTRIC EQUIPMENT CO.
ROCHESTER 1, NEW YORK

FOR SALE

1—Nordberg Uniflow Engine, 14x20, direct connected G.E. Generator, 125 KW, 240/3/60.
1—75 H.P., 440 volt, 3 phase, 60 cycle, 720 RPM, Louis Allis, ball bearing, Squirrel Cage unused motor.

CHARLES V. FISH
501 Commonwealth Bldg., Allentown, Penna.

COMPLETE POWER PLANTS
STEAM — ELECTRIC — HYDRO — DIESEL
"Expert Orders Carefully Executed"

BOILER UNITS

1—140,000# New Steam Generator 600#, also Super
2—90,000# Boilers, 625#, 825° F.tt., Economizer and Air-heater
2—60,000# MODERN Boilers 450#
2—30,000 MODERN Steam Generators 450#
3—1000 HP Vogt 300# with Super
3— 750 HP Stirling Type Boilers 200#
2— 600 HP B&W Sectional header 200# Boilers
1— 400 HP B&W Co. Sectional—Super 200 to 350#
4— 500 HP B&W Sectional Header 200# Boilers
2— 350 HP Straight Tube 200# Boilers
Also smaller Boilers & Fire Tube Boilers

TURBO UNITS

1—20,000 KW Turbo-Generator—Cond.
1—10,000 KW Turbo-Generator—Cond.
1— 7,500 KW Turbo-Generator—Cond.
1— 5,000 KW Turbo-Generator—Cond.
2— 2,500 KW same as above
2— 2,000 KW same as above } Also 400 &
2— 1,500 KW same as above } 600& turbos
2— 1,250 KW same as above
2— 1,000 KW same as above
1—500 KW same—Also 750 KW & 300 KW Units
Non-Cond.:—300—500—750—1000—1500—2000

COMPLETE STEAM PLANTS: One with 2-1500 KVA's, One of 2500 KVA & One of 7500 KVA.
Frequency Changers—Transformers! Send us your requirements—We may have it.
Send us your INQUIRIES *for* ALL POWER MACHINERY

CHARLES B. REARICK 30 CHURCH ST. NEW YORK 7, N. Y.

Most all units still on foundation. Many may be seen operating

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2500 KVA Al. Chal. 2300/4160 v., 400#
1625 KVA Wghse. 2300 v., 150# (bleeder)
1250 KVA Elliott 2300 v., 200# (bleeder)
1250 KVA (2) Elliott 480 v., 150/200#
1250 KVA Wghse. 2300 v., 450#
1250 KVA GE 4150 v., 200#
937 KVA Elliott 2300 v., 175# (bleeder)
750 KVA GE 2300 v., 200#
625 KVA (2) GE 2300 v. 150/200#
375 KVA Wghse. 220/110 v., 100/125#
375 KVA Al. Chal. 480/240 v., 190#

TURBO UNITS (Non-Cond.)

937 KVA Al. Chal. 480 v., 150#
750 KVA GE 550 v., 70# BP
625 KVA GE 2300 v., 150/200#
250 KVA GE 690 v., 150/200#
62½ KVA; 112 KVA; 125 KVA; 200 KVA and 250 KVA GE 480/220 v. units

DIESEL UNITS

282 KVA Wghse.-GM 240/480 v.
250 KVA (2) Buckeye 2300/480 v.
250 KVA FM 2400/480/240 v.
200 KVA FM-FM: 2400/480/240 v.
156 KVA Ideal-Buckeye 240/480 v.
109 KVA GE-Superior 240/480 v.
106 KVA GE—Murphy (portable) 220/440 v.
75 KVA (2) GM, 2400 volts
75 KVA (2) GM 480/240 v.
37½ KVA GM 240 v.

BOILERS

625 HP Vogt bent tube 450#
600 HP (2) B&W Sec. Header, 200#
540 HP Keeler 250#
509 HP Sterling, 250#
490 HP (2) Erie City 3 drum, 160#
487 HP Sterling 200#
400 HP Erie City, Heine type, 200#
250 HP (3) Titusville fire box 125#
250 HP (2) Oil City, 160#
250 HP (2) B&W 3 drum, 160#

STEAM ENGINE SETS, A.C.

500 KVA GE-Skinner Unif.
450 KVA GE-Ames Unif. Cond.
400 KVA GE-Erie Ball 4 v.
312 KVA GE-Chase 4 v.
312 KVA GE-Ames Unif.
312 KVA (2) CW-Skinner Unif.
240 KVA GE—Nordberg Unif.
187 KVA GE-Chase 4 v.
187 KVA Wghse.-Ames Unif. Ver.
62½ KVA GE-Ames Unif.

PUMPS — MOTOR DRIVEN
COMPRESSORS — MOTOR DRIVEN
TRANSFORMERS
MOTOR GENERATOR SETS

POWER PLANT EQUIPMENT CO., INC.
39 Cortlandt St.
New York, N. Y.

Quality SINCE 1906 — Wente Motors — WIDE SELECTION UNUSUAL VALUES

THEIR ELECTRICAL CONSTRUCTION HAS BEEN REBUILT . . . BY EXPERTS

SQUIRREL CAGE
3 ph.—60 cy.—220 or 440 V.
(Other voltage as noted)

Qu.	HP	Make	Type	Speed
1	50	G.E.	I (2200 V.)	900
2	50	Al. Ch.		900
1	60	G.E.	KT	1800
6	60	G.E.	KT (2200 V.)	1200
1	60	Reliance	AA	900
1	75	G.E.	KT	1250
1	100	G.E.	KT (2200 V.)	900
6	100	G.E.	K (TEFCSB)	1200
1	110	G.E.	KTP	1800
1	120	G.E.	PT	3600
2	125	Cr. Wh.	126Q	450
8	125	Al. Ch.	AB	450
2	150	Al. Ch.		1750
1	250	G.E.	I-17	900
1	250	G.E.	KP (Vert.)	3600

SLIP RING—SYNCHRONOUS
3 ph.—60 cy.—220 or 440 V.
(Other voltage as noted)

1	50	Al. Ch.	AV	720
1	50	Ideal	AV	600
1	50	G.E.	I	700
1	60	Ideal	AVX	1200
1	75	West.	CW	600
1	75	G.E.	I	520
1	75	Fair. Morse	BV (2200 V.)	1800
1	100	G.E.	THB (1.0 PF)	600
1	100	G.E.	I-16 (2200 V.)	450
1	100	West.	CW (S.P.)	1800
1	100	KW G.E.	ATB (.8 PF)	900

Qu.	HP	Make	Type	Speed
1	125	Fair. Morse	T (2400V)(PF1.0)	900
1	150	G.E.	TS (.8 PF)	1800
1	150	West.	CW	450
1	200	G.E.	TRC (.8 PF)	400

D.C.—230 Volt
(Other voltage as noted)

1	30	West.	SK	850
1	50	G.E.	CD 1341	500/2000
3	50	Reliance	Y	2700
1	50	West.	SK (115 V.)	500
1	60	West.	SK (115 V.)	500/1500
1	75	Diehl	K11	700
1	100	West.	SK	850
1	100	Cr. Wh.	CM	600
1	120	Cr. Wh.	CMC (550 V.)	1200
1	150	West.	SK	850
1	180	Cr. Wh.	CMC	450
2	200	G.E.	TLC-74	1350/4000

M-G SETS

1— 45 KW West. 60 V DC—440 V AC 1200 RPM
4— 60 KW G.E. 60 V DC—440 V AC 1200 RPM
2— 75 KW El. Prod. 220 V DC—440 V AC 1200 RPM
1—100 KW Reliance 250 V DC—220 V AC 1200 RPM
1—100 KW Ridge 250/275 V DC—440 V AC 1200 RPM
1—105 KW Century 70 V DC—440 V AC 1200 RPM
1—150 KW G.E. 250/275 V DC—440 V AC 900 RPM
ALSO—4000 motors other than listed from 1 HP to 200 HP

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NEW IN 1937
2—G.E. 4500 KVA 3 Ph. 60 cycle 27,000 V. Prim. 2300 V. Sec.
1—American 5000 KVA 3 Ph. 60 cy. 27,000 V. Prim. 2300 V. Sec.
BARGAIN PRICE $1 PER KVA
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TRANSFORMERS
3—General Electric, Single Phase, Type "HS", Form WD Transformers, Voltage 13,200—2,400/4160 Y, K.V.A. 333, 60 Cycles, Subtractive Polarity, 55° Centigrade Temperature Rise, Total Weight each approximately 4175 lbs.
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Baltimore 3, Md. *Attention. Mr. Jan Porel*

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Horizontal Water Cooled—Any size also 2 Stage portable unit
L. W. BAUER
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PIERCE CABLE CO.
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Steam Turbo Unit 4000-5000 KW Marine Type 150 or 200 HP mtr. 3 ph., 60 cy., 720 or 900 RPM 30 & 45 K.V. Insulators
Circuit Breakers 7500 volts 100,000 KVA Interrupting capacity or greater.
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CHICAGO 4, ILLINOIS

WANTED TO BUY
Oil Separating Centrifuge, DeLaval or similar.
EAST FOUNDRY
Box 395, Rochester, New York

WANTED
Left Hand Corliss Steam Engine with following specifications or slightly larger—Size—18"x30"; Speed of engine—120 RPM; Steam pressure—125 pounds; Fly Wheel—11' Diameter, 30"-36" Face. Would like to know overall dimensions.
LEHIGH SEWER PIPE & TILE COMPANY
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330 West 42nd Street
NEW YORK 18, N. Y.

SLIP RING MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Speed
450	440/220	Whse.	514
250	2300/440	Whse.	900
500	440/220	Whse.	514
300	440/220	Whse.	900
300	2300/440	G.E.	1200
300	440	G.E.	458
150	440/220	Whse.	600
150	440/220	Whse. (2)	1200
150	2300/440	G.E.	1200
150	440/220	G.E.	720
100	440/220	G.E.	600
100 (2)	440/220	Whse.	900
100	2200/550	G.E.	1800
80	440/220	G.E. (MTC)	900
75	2200/550	G.E.	1800
75	440/220	Whse. 25 cy.	750

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
600	2300/440	G.E.	T.S.	1200
400	440/220	G.E.	ATI	600
300	2200/440	G.E.	TS	720
300	440/220	G.E.	ATI	600
250	440/220	Whse.	HR	277
250	440/220	G.E.	ATI	600
240	440/220	Whse.	G	1800
200	440/220	G.E.	TS	720
200	4150/2300	Whse.	G	1800
120	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	Whse.	G	1800
75	2200/440	Whse.	GE	600

GENERATOR SETS

1—62½ kva. 1200 rpm, 230 volt, Whse., geared to 7800 rpm, Whse., neo-cond. steam turbine, 150 lbs. pr.
2—unused 25 kva, 120/208 v., 3 ph., 1200 rpm, generator dir. conn. to Waukesha 6 cyl. gas engine

AIR COMPRESSOR UNIT

1—13" and 8" by 10" Worthington FEATHER-VALVE, 285 rpm, 110 lbs. ga. motor-driven.

CIRCUIT BREAKERS

2—2000 amp., GG E, 3 pole, 600 v., air
3—1600 amp., ITE, 3 pole, 600 v., air
2—1200 ampere, Whse., 3 pole, 600 v., air

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	900
350	2200	G.E.	KT	1200
300	2200/550	Whse.	CS	1800
250	440	G.E.	KT	900
250	2300/440	L. Allis	OGS	1200
200	440	G.E.	IK	514
200	440/220	Whse.	OS	1200
200	440/220	G.E.	KT	1200
200	2200/440	G.E.	KF	720
200	2200/550	Cr. Wh.	SC	900
200	2200/440	G.E.	KT	1200
200	440/220	G.E.	IK	450
150	440/220	G.E.	IK	450
100	2200/550	Whse.	CS	900
150	440/220	G.E.	KT	720
150	440/220	G.E.	IK	514
125	440/220 (2)	G.E.	IK	514
125 vert.	440/220	G.E.	KTP	1200
100	550	Cr. Wh.	Q	900
100	2200/440	G.E.	K	1200

A. C. GENERATORS

1—320 kva, 600 rpm, 2300/440/220 V., G.E.
1—250 kva, 720 rpm, 2300/440 v., G.E.
1—250 kva, 600 rpm, 2200/440 v., G.E.
1—225 kva, 600 rpm, 220/440 v., G.E.
1—210 kva, 1800 rpm, 440/220 V., Whse.
1—100 kva, 1200 rpm, 440/220 V., Whse.

D. C. MOTORS

HP	Volts	Make	Type	Speed
350	230 (2)	G.E.	CD	1150
250	230 (2 new)	Cr. Wh.	CMC	1800
200	230	Cr. Wh.	CMC	900
150	230 (new)	Cr. Wh.	THFC	900
100	230	Cr. Wh.	CMC	625
100	230	G.E.	CD	1750
75	230	G.E.	CD	1150
75	230	Whse.	SK	850

MOTOR GENERATOR SETS

1—300 kw, 1200 rpm, 250 v., G.E., connected to 500 hp, 1200 rpm, 2300/440 v., synchronous
1—165 kw, 1200 rpm, 240 v., G.E., conn. to 250 hp, 1200 rpm, 440/220 v., squirrel cage
1—125 kw, 1200 rpm, 250/120 v., G.E., conn. to 175 hp, 1200 rpm, 4000/2300/440 v., synchronous
1—100 kw, 250 v., Hertner, 1200 rpm, connected to 150 hp, 2200/440 v., synchronous
1—90 kw, 1200 rpm, 250 V., G.E., connected to 125 hp 2200/440 V. squirrel cage motor
1—75 kw, 125 v., 1200 rpm, G.E. conn. to 120 hp, 2200/440 v., syn. motor.

TRANSFORMERS 60 Cy.

2—667 kva, Whse., 33,000—2300 V.
3—400 kva, G. E., 13,800/6900—230/460 V.
3—333 kva, Whse., 4800/2400—240/480 V.
3—250 kva, G. E., 4800/13,800—230/460 V.
3—200 kva, Whse., 13,200—2300 V. (Inverted)
3—200 kva, G. E., 2400—240/480 V.
3—150 kva, G.E., 2400—240/480 V.
6—150 kva, Al. Chal., 2400—240/120 v.
1—150 kva, Whse. SK, 13200-125/215 v., 3 ph
3—100 kva, G. E., 4600/2300—230/460 V.
3—100 kva, G.E., 13800—230/115 v., NEW
6—100 kva, G.E., 4600/2300-230/115., NEW
3—100 kva, G.E., 460-115/230 v., dry, 1 ph, rev
2—75 kva, G.E., 480—240/120 V. Pyranol
3—50 kva, G.E., 480—240/120 V., Pyr.

STEPHEN HALL & CO.

HARRY J. RICE PRES.

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Availability of economical steam and electrical energy supply and an urgent need for space for his expanding business caused owner to shut down this plant, containing:

2—1250 KW Westinghouse turbine generators with condensers and auxiliaries, installed 1914.
1—3500 KW Westinghouse turbine generator with condenser and auxiliaries, installed 1926.
Dual drive exciter sets.
Switchboard (550 volt, 3 phase, 60 cycle)
4—600 H.P. B. & W. 3-drum, straight tube boilers, with superheaters, soot blowers, etc., installed 1912.
2—600 H.P. B. & W. as above, installed 1919. All boilers have Bailey boiler meters, installed in 1931.
2—American Blower Company forced draft fans, cap. each. 70,000 cfm at 6", with Terry turbine drives.
1—250 gpm Worthington feed pump, rebuilt 1934 with 60 H.P. turbine.
2—450 gpm Worthington pump and turbine installed 1937. Coal handling equipment, capacity 40 ton/hr. including 2 track hoppers, pan conveyor, crusher, elevator, belt conveyor, Merrick weightometer, silo 24' dia. 46' high, belt conveyor and tripper over bunker, and
6—Richardson scales. Furnished by Stephens-Adamson in 1931.

Ash handling equipment, including Beaumont-Birch skip hoist and overhead ash bunker installed 1931.

Feed water heater, Cochrane #253, installed 1923.

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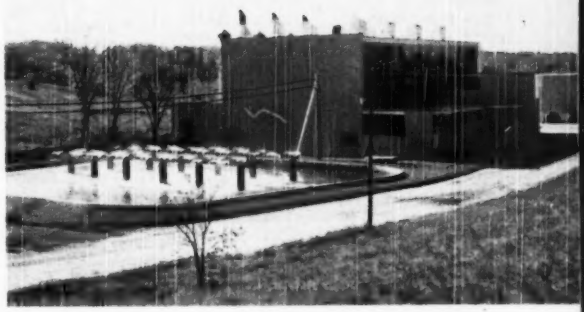

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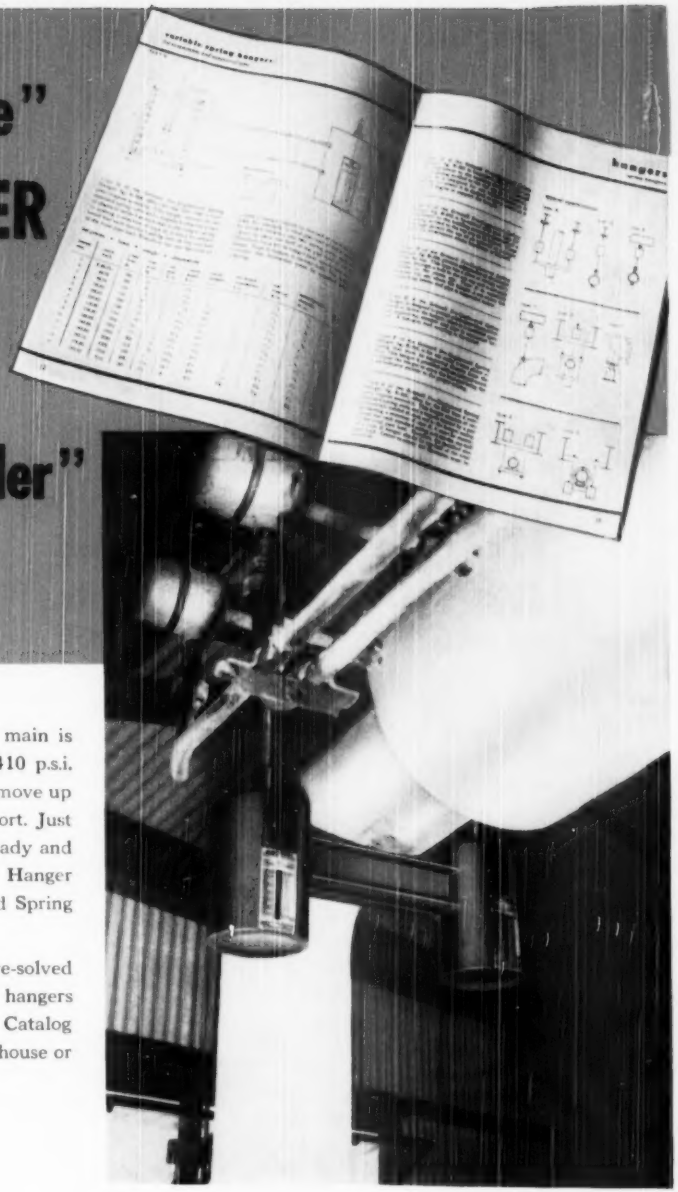

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